FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE FOR BIDDING

FORM OF PROPOSAL
NCPD 2nd Precinct Station House
7700 Jericho Turnpike / Woodbury, NY
GENERAL CONSTRUCTION
CONTRACT NO.: B50680-PCT2G1
This project shall be administered under a Project Labor Agreement

Item No.	Type	Description		
01	LUMP SUM (Base Bid)	LUMP SUM for furnishing all labor, materials and equipment required for all **General Construction** work associated with the foundation for a new +/- 25,000 sq. ft. two story precast concrete Station House with steel framed penthouse, associated site improvements including grading, drainage, lighting, paving, make complete and ready for operation.		
02	LUMP SUM (Base Bid)	LUMP SUM for furnishing all labor, materials and equipment required for **Mechanical Construction** work, make complete and ready for operation.		
03	LUMP SUM (Base Bid)	LUMP SUM for furnishing all labor, materials and equipment required for **Electrical Construction** work, make complete and ready for operation		
04	LUMP SUM (Base Bid)	LUMP SUM for furnishing all labor, materials and equipment required for **Plumbing Construction** work, make complete and ready for operation		
05	LUMP SUM	LUMP SUM for furnishing all labor, materials and equipment required for preparation and updating of **CPM (Critical Path Method) Progress Schedule** for the duration of the Project. Note: The Lump Sum bid amount shall not be less than One Hundred Twenty-Five Thousand Dollars and Zero Cents ($125,000.00).		
06	ALLOWANCE	Include in bid an allowance of One Hundred Thousand Dollars ($100,000.00) for testing, removal, and disposal of any contaminated soils, construction spoils, or the like, encountered during the course of construction.	$100,000	00
07	ALLOWANCE	Include in bid an allowance of One Hundred Thousand Dollars ($100,000.00) for fees requested by any utility or telecom provider for connection fees, or specialized utility or telecom work not specifically characterized in the contract documents	$100,000	00
08	ALLOWANCE	Include in bid an allowance of Five Hundred Thousand Dollars ($500,000.00) for items unforeseen or not specifically characterized in the contract documents, encountered during the course of construction as directed by the County.	$500,000	00
09	ALLOWANCE	Include in bid an allowance of Two Million Dollars ($2,000,000.00) for costs incurred from conditions beyond the control of the Contractor to maintain the project schedule where delays cannot be accepted due to the “Emergency” declaration for this project to protect public safety, as directed by the County.	$2,000,000	00

FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE FOR BIDDING

FORM OF PROPOSAL
NCPD 2nd Precinct Station House
7700 Jericho Turnpike / Woodbury, NY
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BASIS OF AWARD: Bids on Lump Sum Contracts will be compared on the basis of the total bid price, arrived at by taking the Sum of each Bid Item, including Allowance Item(s), if any, and plus or minus the cost difference of the Alternate(s), if any, as may be selected by the Architect and/or Owner. **The sum of all "Amounts Bid" will determine the low bidder and the subsequent award of this Contract.**

BID SECURITY: Prospective bidders are cautioned to carefully review the requirements of Paragraph H, Bid Security, of The Instructions to Bidders.

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SECTION 010100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work Sequencing.
4. Owner-furnished products.
5. Use of premises.
6. Owner's occupancy requirements.
7. Work restrictions.

B. Related Sections:

1. Division 1 Section "Temporary Construction Facilities" for limitations and procedures governing temporary use of Owner's facilities.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Nassau County Police Second Precinct Station House.

1. Project Location: 7700 Jericho Tpke. Woodbury, NY.

B. Owner: Nassau County Department of Public Works, 1194 Prospect Avenue, Westbury, NY 11590.

C. Owner's Representative: Nassau County Department of Public Works, 1194 Prospect Avenue, Westbury, NY 11590.

D. Architect: LiRo Architects + Planners, P.C., Three Aerial Way, Syosset, NY 11791.

E. Construction Manager: To be determined by Owner

1.3 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.4 WORK SEQUENCING

A. The project will be phased for demolition of the existing Second Precinct Building, and Site work. Sequencing as follows:

1. Sequencing:

a. Provide construction fence to secure site and separate existing precinct building from construction activities.

b. Protect existing Garage Building, Antenna Tower, trailers, and other elements per the Owner

c. Demolish existing Second Precinct Station House and miscellaneous structures as required per the contract documents.

d. Complete site work including underground utilities including power, data, and communications

e. Site grading, excavation, and soil compaction in preparation of the building foundation work

f. Construction of the building concrete foundations as per the drawings and specifications (formwork, steel reinforcement, and concrete pour).

g. Remove construction fence and any temporary construction.

1.5 OWNER-FURNISHED PRODUCTS (not used)

1.6 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy in areas immediately adjacent to the work area, and for access to the existing garage buildings and Nassau County Police Department site trailer for public access.

2. Driveways and Entrances: Keep indicated driveways, loading areas, and entrances serving existing Trailer and Garage building clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner will occupy the existing Trailer and Garage building during the demolition and site work. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage of the existing Trailer and Garage building. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits.

1. Maintain access to existing walkways and other adjacent occupied or used facilities. Do not close or obstruct walkways or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

2. Provide not less than 72 hours notice to Owner of activities that will affect Owner's ongoing operations.

1.8 WORK RESTRICTIONS

A. Refer to Supplemental Conditions by the County for work hour restrictions.

B. Existing Utility Interruptions: No interruption of utilities serving facilities occupied by Owner or others during normal business hours will be permitted. All utility interruptions must be performed after normal hours, and only after coordination with the County.

1. Notify County not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without County’s written permission.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010100

SECTION 010150 - VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, AND ARCHITECTURAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for reduced-emission, reduced-toxicity construction adhesives, sealant and architectural coatings.

B. Material Safety Data Sheets (MSDS) required and readily available on site.

C. RELATED SECTIONS:

1. All sections in the Specifications with interior adhesive or sealant applications.

2. Painting: Division 9.

1.2 REFERENCE STANDARDS / QUALITY ASSURANCE

A. Adhesives (VOC Content): South Coast Air Quality Management District Rule #1168 - "Adhesive and Sealant Applications", amended 1/7/05: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

B. Sealants: (VOC Content): Regulation 8 (Organic Compounds), Rule 51 (Adhesive and Sealant Products), amended 5/2/01: Bay Area Air Quality Management District (BAAQMD), State of California, www.baaqmd.gov.

C. Paints: (VOC Content and Prohibited Compounds): "Green Seal Standard for Architectural Coating" (GS-11), plus "Green Seal Standard for Anti-Corrosive Paints" (GC-03).

D. Anticorrosive Paints: "Green Seal Standard for Anti-Corrosive Paints" (GC-03), Second Edition, 1/7/07.

E. Clear Wood Finishes, Floor Coatings, Stains, Sealers, Shellacs (VOC Content): South Coast Air Quality Management District Rule #1113, "Architectural Coatings," 1/1/04.

1.3 DELIVERY AND STORAGE

A. To the extent feasible, do not store adhesives, sealants, paints, and other Architectural coatings with materials that have a high capacity to adsorb VOC emissions (i.e., materials which are woven, fibrous or porous in nature, such as acoustical ceilings, textiles, etc.). Do not store adhesives, sealants, paints, and other Architectural coatings in occupied spaces.

PART 2 - PRODUCTS

2.1 MATERIALS

A. VOC Content of Adhesives:

1. The volatile organic compound (VOC) content of adhesives shall not exceed the limits defined in Rule #1168, "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California. The VOC limits defined by SCAQMD (based on 1/7/05 amendments) are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds (determined by U. S. EPA Reference Test Method 24). Unless otherwise specified below, the VOC content of all adhesives, adhesive bonding primers, or adhesive primers shall not be in excess of 250 grams per liter.

2. Architectural Applications:

a. Wood flooring adhesive: 100.

b. Subfloor adhesive: 50.

c. Ceramic tile adhesive: 65.

d. Drywall and panel adhesive: 50.

e. Cove base adhesive: 50.

f. Multipurpose construction adhesive: 70.

g. Structural glazing adhesives: 100.

3. Specialty Applications:

a. PVC welding: 510.

b. CPVC welding: 490.

c. ABS welding: 400.

d. Plastic cement welding: 250.

e. Adhesive primer for plastic: 550.

f. Contact adhesive: 80.

g. Special purpose contact adhesive: 250.

h. Structural wood member adhesive: 140.

i. Sheet applied rubber lining operations: 850.

j. Adhesive Primer for Traffic Marking Tape: 150.

4. Substrate specific applications:

a. Metal to metal: 30.

b. Plastic foams: 50.

c. Porous material (except wood): 50.

d. Wood: 30.

e. Fiberglass: 80.

5. If an adhesive is used to bond dissimilar substrates together, the adhesive with the highest VOC content shall be allowed.

B. VOC Content of Sealants and Sealant Primers:

1. The volatile organic compound (VOC) content of sealants and sealant primers shall not exceed the limits defined in Rule #1168, "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California. The VOC limits defined by SCAQMD (based on 1/7/05 amendments) are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds (determined by U. S. EPA Reference Test Method 24).

2. Sealants:

a. Architectural: 250.

b. Non-membrane Roof: 300.

c. Roadway: 250.

d. Other: 420.

3. Sealant Primers:

a. Architectural Non-Porous: 250.

b. Architectural Porous: 775.

c. Other: 750.

C. VOC Content of Aerosol Adhesives:

1. The volatile organic compound (VOC) content of aerosol adhesives shall not exceed the limits defined in "Green Seal Standard for Commercial Adhesives" (GS-36), 10/19/00. All VOC limits are defined in grams per liter, less water and less exempt compounds (determined by U. S. EPA Reference Test Method 24).

2. Aerosol Adhesives:

   a. General Purpose Mist Spray - 65% VOCs by weight.

   b. General Purpose Web Spray - 55% VOCs by weight.

   c. Special Purpose Aerosol Adhesives, all types - 70% VOCs by weight.

D. VOC Content of Paints:

1. The Volatile Organic Compound (VOC) content of paints shall not exceed the limits defined in the "Green Seal Standard for Architectural Coating" (GS-11) as of 5/20/93. The VOC limits are as follows. All VOC limits are defined in grams per liter, less water.

2. Paint:

   a. Non-flat interior coatings: 150.

   b. Flat interior coatings: 50.

E. VOC Content of Anti-Corrosive Paints:

1. The Volatile Organic Compound (VOC) content of paints shall not exceed the limits defined in the "Green Seal Standard for Anti-Corrosive Paints" (GC-03), Second Edition, 1/7/07. All VOC limits are defined in grams per liter, less water.

2. Anti-Corrosive Paints: 250.

F. VOC Content of Clear Wood Finishes, Floor Coatings, Stains, Sealers, Shellacs:

1. The Volatile Organic Compound (VOC) content of paints shall not exceed the limits defined in the South Coast Air Quality Management District Rule #1113, "Architectural Coatings," 1/1/04.

2. Clear Wood Finishes:

   a. Varnish: 350.

   b. Lacquer: 550.

3. Floor Coatings: 100.

4. Sealers:

a. Waterproofing Sealers: 250.

b. Sanding Sealers: 275.

c. Other Sealers: 200.

d. Stains: 250.

G. Prohibited Compounds in Paints:

1. Paints shall comply with the prohibited compound requirements of the "Green Seal Standard for Architectural Coating" (GS-11), Green Seal, Washington D.C.

2. Prohibited compounds, as defined in the green seal standard, shall include:

a. Halomethanes: methylene chloride.

b. Chlorinated ethanes: 1,1,1 trichloroethane.

c. Aromatic solvents: benzene, toluene (methylbenzene), Ethylbenzene.

d. Chlorinated ethylenes: vinyl chloride.

e. Polynuclear aromatics: naphthalene.

f. Chlorobenzenes: 1.2 dichlorobenzene.

g. Phthalate esters: di (2-ethylhexyl) phthalate, Butyl Benzyl Phthalate, di-n-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate.

h. Miscellaneous semi-volatile organics: isophorone.

i. Metals and their compounds: antimony, cadmium, hexavalent chromium, lead, mercury.

j. Preservatives (antifouling agents): formaldehyde.

k. Ketones: methyl ethyl ketone, methyl isobutyl ketone.

l. Miscellaneous volatile organics: acrolein, acrylonitrile.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of all adhesives, sealants, paints, and coatings with the ventilation and sequencing criteria defined in Specification section 01511 Construction IAQ Management.

B. When installed over concrete slabs, verify compatibility of adhesives with curing compounds, leveling agents, or sealing agents used for slab preparation.

END OF SECTION 010150

SECTION 010400 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conferences required after the Notice to Proceed but prior to commencement of construction activities, and describes the requirements for Project Progress Meetings during the execution of the Work.

1. Contractor shall coordinate all elements of the work and coordinate the work with existing facilities/conditions, and with work of other affected trades, and the Construction Manager.

2. The requirements included herein shall constitute the minimum coordination and supervision necessary for coordination of work on the project to be fulfilled by the Contractor.

3. Any additional cost resulting from lack of coordination between each of the Prime Contractors will be paid by responsible Contractor (as determined by the Architect and the Construction Manager) at no cost to the Owner.

B. Related Sections:

1. Submittals: Elsewhere in Division 1.

1.2 DESCRIPTION OF WORK

A. Meetings: The Construction Manager will call as many meetings with the Contractor as are necessary to resolve any conflicts that become apparent. Meetings and conferences shall take place at the project site or some other location satisfactory to both the Construction Manager and the Contractor. Meetings will include but are not limited to the following.

B. Attendance: All meetings called by the Construction Manager shall be attended by the following personnel:

1. The Construction Manager.

2. Contractor's superintendent.

3. Contractor's quality control supervisor, as appropriate to the agenda.

4. Contractor's site safety and health officer as appropriate to the agenda.

5. Subcontractors as appropriate to the agenda.

6. Suppliers as appropriate to the agenda.

7. Architect/consultants and others as appropriate or as requested by the Construction

Manager.

C. Report of the Meeting: The Construction Manager shall be responsible for recording the report of all meetings and shall include all significant proceedings and decisions. The Construction Manager will reproduce and issue report of the meetings to each participant and to interested parties.

D. Preconstruction Conference: Within 5 working days of issuance of the Notice to Proceed, the Contractor shall meet with the Construction Manager for a preconstruction conference. The purpose of this conference is to review submittal procedures, safety, payment procedures and labor relations, environmental protection, progress schedules, and procurement of materials. The principal features of work shall also be reviewed and any questions regarding the Contract and work site shall be addressed. Attendance by the Contractor's quality control personnel, safety personnel, and any key subcontractors' superintendent will be required.

1. At least 5 working days prior to this meeting, Contractor shall submit 5 copies of the following:

   a. Contractor Quality Control Plan (CQCP).

   b. Site Safety and Accident Prevention Plan.

   c. Site Security Plan.

   d. Materials Handling Plan.

   e. Construction Phasing and Site Logistics Plan.

2. The purpose of this conference is to further define the Quality Control Plan, to thoroughly review the CQCP, and to develop a mutual understanding of the specific requirements established by the Contract. The specifics of the Contractor's other submittals shall also be discussed so that the emergency procedures and health and safety requirements are understood by all those performing work at the site.

3. The above-listed items will be briefly reviewed to provide the Construction Manager with a general understanding of the Quality Control Plan. The Contractor's schedule, particularly for the initial start-up period, shall be discussed. Questions concerning the administrative requirements outlined during the preconstruction conference or any other aspect of the project may also be addressed.

E. Progress Meetings: The Construction Manager shall schedule and administer progress meetings at a minimum of once every two weeks and additionally, as requested by the Construction Manager, the Architect, or the Contractor, to address issues or matters of particular interest or concern related to the project.

1. Meeting requirements: The Construction Manager shall:

   a. Prepare agenda for meetings.

b. Make physical arrangements for meeting.

c. Preside at meetings.

d. Record the report of meetings; include significant proceedings and decisions.

e. Distribute pervious meeting reports.

2. Suggested agenda: The following is a suggested agenda for progress meetings:

a. Review and approval of report of previous meeting.

b. Review of work progress since previous meeting.

c. Field observations, problems, conflicts.

d. Problems which impede the schedule, and proposed corrective actions.

e. Review of delivery schedules.

f. Corrective measures and procedures to regain projected schedule.

g. Revisions to project schedule.

h. Projected progress during succeeding work period.

i. Coordination of schedules.

j. Review of submittal schedules.

k. Maintenance of quality and safety standards.

l. Pending of changes and substitutions.

m. Review of proposed changes for effect on construction schedule and on completion date.

n. Other business as appropriate.

F. Preinstallation Conference: Prior to starting installation of each major work component, a preinstallation conference will be held, attended by the Contractor's superintendent, the Contractor's Quality Control Supervisor and each entity involved or affected by the planned installation, and technical representatives of product manufacturers and others recognized as expert or otherwise capable of influencing success of the installation.

G. Coordination/Foremen Meetings: Once construction commences, a Foremen's Meeting will be called every Monday to coordinate work between the trades. Foremen for all the trades will be required to attend.

H. Pre-Construction Meeting for Facility Coordination: A meeting with the facility must be held prior

to the start of work to coordinate the Contractor's proposed work plan, schedules, phasing, site logistics, safety, and other concerns. A meeting with the Construction Manager will be held prior to the meeting with the facility to prepare for the meeting with the facility.

I. Pre-scheduling Meeting: Within five calendar days of issuance of the Notice to Proceed, the Contractor shall meet with the Construction Manager for a pre-scheduling conference. The purpose of this conference is to review the specified project scheduling requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010400

SECTION 010450 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. The General Contractor shall do all cutting and fitting in connection with his work that may be required to make its several parts come together properly and fit to receive or be received by work of other Contractors and subcontractors as shown upon or reasonably implied by the Drawings and Specifications for the completed structure.

B. Notwithstanding the above, the following conditions shall prevail:

1. Perimeter Precast Concrete, Precast Concrete Interior Walls, Precast Concrete Girders and Beams, Precast Concrete Plank:

a. The General Contractor shall identify and coordinate all penetrations and embedments in the concrete required for his work and the work of all trades and subcontractors (Mechanical, Electrical, and Plumbing), prior to fabrication of precast components. Penetrations shall be performed by the precast manufacturer whenever appropriate.

b. The General Contractor shall prepare coordinated shop drawings including sizes and locations, etc. indicating all penetrations and embedments.

c. Each contractor shall provide all sleeves required for utility penetrations and conduit and back-box embedments required for wall-mounted lighting and security fixtures so that these are factory-installed into the precast wall panels by the precast manufacturer. Field installation not permitted.

d. Each contractor is responsible to fireproof and waterproof the sleeve once utilities are installed.

e. All penetrations performed as field conditions following precast fabrication shall be documented in shop drawings and approved by the precast manufacturer prior to execution, in order to safeguard against the cutting of essential rebar and prestressed strand . All field penetrations will be performed by the General Contractor.

2. Interior Walls and Partitions (non precast concrete):

a. Penetrations through interior concrete block walls and Gypsum board walls shall be performed by the General Contractor.

b. Each Subcontractor (Mechanical, Electrical, Plumbing) shall provide shop drawings of all pipe penetrations (sizes, locations, etc.) to the General Contractor. The General Contractor shall coordinate and approve overall penetration plans.

c. Each Subcontractor shall provide sleeves for its penetrations to the General Contractor for installation.

d. Each Subcontractor shall be responsible to fireproof and waterproof the sleeve once

piping, conduit, etc., is installed.

3. Floors and Roofs

a. Cutting of electrical floor boxes and penetrations shall be performed by the General Contractor. The precast concrete manufacturer shall provide approval of penetrations in precast concrete plank. The Electrical Contractor shall provide shop drawings to the General Contractor.

b. All roof penetrations and patching shall be done by the General Contractor. Each Subcontractor shall provide shop drawings of all roof penetrations (sizes, locations, etc.) to the General Contractor.

C. No Contractor shall do any cutting or drilling that will impair the strength of the construction and shall report to the Construction Manager any cutting requested by others that they consider too extensive or that might impair the strength of the construction. No structural members, such as precast concrete walls, precast concrete planks, joists, beams or columns supporting the work shall be cut or drilled without the approval of the precast concrete manufacturer.

D. If through neglect of any Contractor to give required information with regard to cutting of the work of other trades in ample time to prevent unnecessary work, or if, through the delay or mistake of any Contractor, it is necessary to do any additional amount of cutting or replacing of the work, the Contractor requiring the cutting shall pay the General Contractor for such cutting and all necessary patching and repairing in connection with this additional cutting. No Contractor shall endanger any work by cutting, digging or otherwise, and shall not cut or alter the work of any other Contractor save with the consent of the Construction Manager.

E. All required cutting, patching and restoring shall be neatly done by mechanics skilled in their trades and to the satisfaction of the Construction Manager. All cutting of holes through cast-in-place concrete for pipes or conduit shall be core drilled and shall be large enough only to accept the Contractor's work and readily patched.

F. The General Contractor shall be responsible for the patching of openings cut in walls, floors, ceilings, foundations, etc., so as to close around his work in a neat and workmanlike manner. Finish patching shall exactly match the adjoining surfaces such that there is a smooth, uniform, flush and continuous surface free of visual joints, ridges and gaps. Patching shall be performed by the original installer of the work being patched, and at no expense to the Owner.

G. Patched areas requiring painting shall match existing adjacent painted surfaces as closely as practical using the same type of paint. Painting of patched surfaces shall be performed by the original painting subcontractor.

H. The General Contractor shall be responsible for and shall pay for the removal and reinstallation of ceilings and/or light fixtures as necessary to complete the work. Damaged parts shall be replaced with new to match inplace work.

I. The General Contractor shall leave all the work of his Contract whole, complete and perfect at the final completion of the building with no additional charge to the Owner.

1.2 SUBMITTALS

A. For field cutting and patching, submit shop drawings describing procedures. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.

2. Changes to installed construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

3. Products: List products to be used and firms or entities that will perform the Work.

4. Dates: Indicate when cutting and patching will be performed.

5. Architect's approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.

2. Air and smoke barriers.

3. Fire protection systems.

4. Control systems.

5. Communications systems.

6. Conveying systems.

7. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.

2. Membranes and flashings.

3. Exterior wall construction.

4. Equipment supports.

5. Piping, ductwork. vessels, and equipment.

6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. Retain original installer or fabricator to cut and patch exposed work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm which is approved by the Architect/Construction Manager.

a. Concrete finishes.

b. Masonry.

c. Preformed metal panels.

d. Roofing.

e. Firestopping.

f. Window systems.

g. HVAC enclosures, cabinets, or covers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.

5. Mechanical and electrical services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing; all as approved by the Architect/Construction Manager.

3. Floors and walls: Where walls or partitions that are removed 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.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior building enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 010450

ALLOWANCES
SECTION 01 21 00

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULE OF ALLOWANCES

A. List of Allowances:

1. Construction Contingency allowance - an allowance of One Hundred Thousand Dollars ($100,000.00) for testing, removal, and disposal of any contaminated soils, construction spoils, or the like, encountered during the course of construction.

2. Construction Contingency allowance - an allowance of One Hundred Thousand Dollars ($100,000.00) for fees requested by any utility or telecom provider for connection fees, or specialized utility or telecom work not specifically characterized in the contract documents.

3. Construction Contingency allowance - an allowance of Five Hundred Thousand Dollars ($500,000.00) for items unforeseen or not specifically characterized in the contract documents, encountered during the course of construction, as directed by the County.

3. Construction Contingency allowance - an allowance of Two Million Dollars ($2,000,000.00) for costs incurred from conditions beyond the control of the Contractor to maintain the project schedule where delays cannot be accepted due to the “Emergency” declaration for this project to protect public safety, as directed by the County.

3.02 BASIS FOR PAYMENT

A. Construction Contingency allowance;

1. Payment under this allowance shall be paid on the basis of labor, materials and equipment, plus overhead and profit computed in accordance with the requirements of the agreement, Article 21 “Extra Work”. Any funds remaining at the end will be eliminated by a credit change order.

END OF SECTION 01 21 00

SECTION 013000 - SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and its Subcontractors as described herein.

B. Section Includes:

1. Preparing and processing of submittals for review and action.

2. Preparing and processing of informational submittals.

C. Submit the following for the Architect's/Engineer's review and action:

1. Shop drawings.

2. Product data.

3. Samples.

4. Material Safety Data Sheets (MSDS).

D. Submit the following as informational submittals:

1. Certificates.

2. Coordination drawings.

3. Reports.

4. Qualification statements for manufacturers/installers.

5. Progress photographs.

E. Specific submittals are described in individual sections.

1. Provide other information required by Divisions 21 and 22 for fire and plumbing suppression work, respectively.

2. Provide other information required by Division 23 for mechanical work.

3. Provide other information required by Division 26 for electrical work.

F. Do not commence work which requires review of any submittals until receipt of returned submittals with an acceptable action.

G. Do not allow submittals without an acceptable action marking to be used for the project.

H. Transmit all submittals to the Architect/Engineer, with copy to the Construction Manager.

I. Related Sections: The following are specified elsewhere in Division 1:

1. Quality control submittals, including inspection reports and test reports.

2. Shop drawings regarding penetrations through walls, partitions and floors; including cutting and patching requirements. Refer to Section 01045.

1.2 DEFINITIONS

A. Shop Drawings: See General and Supplemental Conditions.

1. Shop drawings also include:

a. Product data specifically prepared for this project.

b. Shop or plant inspection and test reports, when made on specific materials, products, or systems to be used in the work.

B. Product Data: See General and Supplemental Conditions.

1. Product data submittals also include:

a. Performance curves, when issued by the manufacturer for all products of that type.

b. Selection data showing standard colors.

c. Wiring diagrams, when standard for all products of that type.

C. Samples: See General and Supplemental Conditions.

D. Informational Submittals: Submittals identified in the contract documents as to be submitted for information only.

E. Material Safety Data Sheets (MSDS): Submit for all materials unless otherwise indicated.

1.3 FORM OF SUBMITTALS

A. Shop Drawings and Product Data: Submit PDF's in electronic forms via upload to the Architect's project management software. Provide three (3) full size paper copies of all Approved shop drawings for the Owner's records.

B. Samples: 4 sets of each; one set will be returned.

1. Size of samples: 12 inches long for linear products, and 12 inches by 12 inches for sheet/panel products.

C. Progress Photographs: 8 by 10-inch glossy color prints with muslin backing and mounting edge. Furnish three (3) prints of twelve (12) locations each plus a compact disc of electronic files

(JPEG) of individual views, assembled in separate (3) binders with clear view description of each photo with dates, location and times on a monthly basis.

D. Material Safety Data Sheets (MSDS): Manufacturer's standard sheets, but not less than 11 inches by 7-1/2 inches; 4 copies required for each product plus an electronic PDF copy.

E. Maintenance Instructions: Submit 4 paper copies in 3-ring binders plus a compact disc in PDF format for each product/system.

H. If additional sets are needed by other entities involved in work represented by the samples, submit with original submittal.

I. Copies in excess of the number requested will not be returned.

J. Provide additional copies for project record documents.

1.4 COORDINATION OF SUBMITTALS

A. Coordinate submittals and activities that must be performed in sequence, so that the Architect has enough information to properly review the submittals.

B. Coordinate submittals of different types for the same product or system so that the Architect has enough information to properly review each submittal.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TIMING OF SUBMITTALS

A. Deliver each submittal requiring approval in time to allow for adequate review and processing time, including resubmittals if necessary; failure of the Contractor in this respect will not be considered as grounds for an extension of the contract time.

B. Deliver each informational submittal prior to start of the work involved, unless the submittal is of a type which cannot be prepared until after completion of the work; submit promptly.

3.2 SUBMITTAL PROCEDURES - GENERAL

A. Notify the Architect/Engineer, in writing and at time of submittal, of all points upon which the submittal does not conform to the requirements of the contract documents, if any.

B. Preparation of Submittals:

1. Label each copy of each submittal, with the following information:

a. Project name.

b. Date of submittal.

c. Respective Prime Contractor's name and address.

d. Architect's name and address.

e. Construction Manager's name and address.

f. Subcontractor's name and address.

g. Supplier's name and address.

h. Manufacturer's name.

i. Specification section where the submittal is specified.

j. Numbers of applicable drawings and details.

k. Other necessary identifying information.

2. Pack submittals suitably for shipment.

3. Submittals to receive Architect's/Engineer's action marking: Provide blank space on the label or on the submittal itself for action marking; minimum 4 inches wide by 5 inches high.

C. Transmittal of Submittals:

1. Submittals will be accepted from the Contractor only. Submittals received from other entities will be returned without review or action.

2. Submittals received without a transmittal form will be returned without review or action.

a. Project name.

b. Submittal date.

c. Transmittal number.

d. Specification section number.

e. To:

f. From:

g. Contractor's name.

h. Subcontractor's and supplier's names.

i. Manufacturer's name.

j. Submittal type (shop drawing, product data, sample, informational submittal).

k. Description of submittal.

l. Records of distribution.

m. Action marking.

n. Comments.

3. Fill out a separate transmittal form for each submittal; also include the following:

a. Other relevant information.

b. Requests for additional information.

3.3 SHOP DRAWINGS

A. Content: Include the following information:

1. Dimensions, at accurate scale.

2. All field measurements that have been taken, at accurate scale.

3. Names of specific products and materials used.

4. Details, identified by contract document sheet and detail numbers.

5. Show compliance with the specific standards referenced.

6. Coordination requirements; show relationship to adjacent or critical work.

B. Preparation:

1. Reproductions of contract documents are not acceptable as shop drawings.

2. Identify as indicated for all submittals.

3. Space for Architect's/Engineer's action marking shall be adjacent to the title block.

3.4 PRODUCT DATA

A. When product data submittals are prepared specifically for this project (in the absence of standard printed information) submit such information as shop drawings and not as product data submittals.

B. Content:

1. Submit manufacturer's standard printed data sheets.

2. Identify the particular product being submitted; submit only pertinent pages.

3. Show compliance with properties specified.

4. Show compliance with the specific standards referenced.

5. Identify dimensions which have been verified by field measurement.

6. Show special coordination requirements for the product.

3.5 SAMPLES

A. Samples:

1. Where unavoidable variations must be expected, submit "range" samples, minimum of 4 units, and describe or identify variations among units of each set.

2. Where selection is required, provide full set of all options.

B. Preparation:

1. Attach a description to each sample.

2. Attach name of manufacturer or source to each sample.

3. Where compliance with specified properties is required, attach documentation showing compliance.

4. Where there are limitations in availability, delivery, or other similar characteristics, attach description of such limitations.

5. Where samples are specified to be returned for installation in the work, indicate such requirement on transmittal form.

C. Keep final sample set(s) at the project site, available for use during progress of the work.

3.6 PROGRESS PHOTOGRAPHS

A. Have progress photographs taken by a professional photographer.

B. Refer to General Conditions for quantity of photographs.

C. Consult Construction Manager/Architect regarding proposed locations for taking photographs.

3.7 REVIEW OF SUBMITTALS

A. Submittals for approval will be reviewed, marked with appropriate action, and returned.

B. Informational submittals: Submittals will be reviewed.

1. "X" action: No action taken.

2. "Not Approved" action: Revise the submittal or prepare a new submittal complying with the comments made.

3.8 RETURN, RESUBMITTAL, AND DISTRIBUTION

A. Electronic submittals will be returned to the Contractor via the Architect's project management software.

B. Samples will be returned to the Contractor by mail.

C. Perform resubmittals in the same manner as original submittals; indicate all changes other than those requested by the Architect/Engineer.

D. Distribution:

1. Distribute returned submittals to all subcontractors and suppliers involved in work covered by the submittal.

2. Make extra copies for operation and maintenance data submittals, as required.

END OF SECTION 013000

SECTION 013200 - CPM (CRITICAL PATH METHOD) PROGRESS SCHEDULE (SINGLE PRIME)

PART 1- GENERAL

1.1 DESCRIPTION

A. The work shall consist of preparing, submitting, and maintaining a computerized CPM (Critical Path Method) progress schedule using Primavera P6 software.

B. The purpose of the computerized CPM progress schedule is to ensure timely completion of the contract and to establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of Scheduling.

C. For this specification, "Engineer" means County authorized Construction Manager.

D. The Contractor shall ensure that any and all computer files submitted to the Engineer are in a format that can be imported directly using Primavera software, version P6 (or as approved by the Engineer).

1.2 DETAILS

A. PRE-CONSTRUCTION SCHEDULE MEETING

1. The Engineer will schedule and conduct a Pre-construction Scheduling Meeting with the Contractor within ten (10) working days after the contract has been awarded. The requirements of this specification will be reviewed at this meeting. Additionally the following topics will be discussed:

   - Specifics of any contract Time-Related Clauses.
   - The representation in the schedule of the Time Related work.
   - The calendar, activity coding, and resource definition requirements unique to and consistent with the contract.
   - The Contractor's schedule methodology employed, proposed work sequence and any proposed deviations of sequences from the contract plans.
   - The factors that the Contractor determines to control the completion of the project and any milestone completions contained therein.
   - Narrative content for Initial Baseline and Monthly Updates.
   - Schedule submission protocol for Initial Baseline and Monthly Updates.

2. The Contractors attendance at the Pre-construction Scheduling Meeting is mandatory. No field work will be allowed, with the exception of set up of the field office, until this meeting is held.

B. INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. Within fifteen (15) work days following the Notice to Proceed, the Contractor shall prepare and submit to the Engineer the Initial Baseline CPM Construction Schedule for the entire project. This submission shall include the electronic Schedule file and paper reports as required and approved by the Engineer.

2. The Initial Baseline Schedule must be cost and resource loaded and shall represent the Contractor's plan to construct the project. This schedule shall include all work and activities necessary to complete the project including but not limited to activities for the preparation, submittal, review, approval, fabrication, and delivery of all shop drawing and procurement related items. The Initial Baseline CPM Construction Schedule must be set up to conform to the staging/phasing and other requirements defined in the contract.

3. The Initial Baseline Schedule shall meet all interim milestone dates and shall not extend beyond the contract completion date.

C. SCHEDULE REQUIREMENTS

The Contractors Initial Baseline CPM Construction Schedule shall meet the following requirements:

CPM ACTIVITY NETWORK FORMAT - The schedule network shall use the Precedence Diagraming Method. (If the contractor desires to employ an alternative method prior approval by the Engineer is required and no changes to the initial submission date will be permitted.)

PROJECT DEFINITIONS - The following project specific properties within the schedule shall be defined:

1. CALENDAR - All calendars created shall encompass and account for the total duration of the contract time period. The standard calendar shall be 8-hour days, five days per week and shall account for holidays and non-working days. Additional calendars shall be created and included as required for:

    a. Work week (5 or 6 day). (When or if the contractor elects to utilize a 6 day work week he shall be responsible for the County's overtime costs as applicable by the contract requirements).
    b. Seasonal restrictions (asphalt, landscape, etc.).
    c. Concrete curing/calendar days.
    d. Shop drawing review.
    e. Any project specifics as required by the Engineer.
    f. Expected and contemplated weather conditions shall be accounted for in the calendars.

2. ACTIVITY CODE - As a minimum following activity codes shall be established:

a. Responsibility - The party responsible for each activity. Only one party can be responsible for an activity. Include Values for "Nassau County Department of Public Works (NC)", "Prime Contractor" and third parties to the contract as appropriate (utilities, etc).
b. Phase - Phasing consistent with Contract plans where each activity is performed; Include Values for "None", and "Project Wide".
c. Location - Location of activity work by Stationing; Include Value for "None", and "Project Wide"
d. Type - The type of work for each activity; Include a Value for Administrative"
e. Added Work - Work added to the Contract and incorporated into the schedule with the Engineers Approval.
f. As Required by Project - Any coding unique to or as required by the Engineer to facilitate the use and analysis of the Schedule. This coding shall be established in consultation with the Engineer at the Pre construction Scheduling Meeting.

3. RESOURCES - The Resource Dictionary shall be established as required by the Engineer. The Resource Dictionary shall be limited to Labor and Equipment. Labor may be represented by work crews. The composition of each crew must be detailed and included as an appendix to the Narrative Report. Sub-Contractors shall be represented as a labor crew(s).

4. COST LOADING – Basis of cost loading will be the **approved** bid breakdown.

5. ACTIVITY DATA

a. ACTIVITY IDENTIFICATION - Each activity shall have a unique identifier. The identifier may be alpha-numeric, but at a minimum must be a unique number.
b. ACTIVITY DESCRIPTION - Each activity shall be unambiguously described. Descriptions such as "construct 30% of Y" are unacceptable. Activities shall be discrete to the extent necessary to accurately schedule the work.
c. ACTIVITY DURATION - Durations of individual work activities shall not exceed fifteen working days. The minimum activity duration increment is one full day. Durations of individual shop drawing review activities may exceed fifteen working days and shall be consistent with Contract Requirements. Exceptions to this will be reviewed by the Engineer on an activity-by-activity basis. If requested by the Engineer, production rates or other supporting information shall be supplied justifying the reasonableness of any given activity time duration. A Method Statement including the labor, equipment, production rates and any additional information, required to achieve a given activity shall be supplied within 5 working days when requested by the Engineer.
d. ACTIVITY RELATIONSHIPS - Activity relationships shall be finish-to-start with no lags unless directed otherwise by the Engineer. Contractor requests for exemptions will be made on a case by case basis. Each activity with the exception of the required "Project Award" and

"Completion" activities shall have a predecessor and a successor activity relationship.

e. ACTIVITY START and FINISH DATES - The earliest start date, earliest finish date, latest start date, and latest finish date shall be calculated for each activity.

f. ACTIVITY TOTAL FLOAT - The total float shall be calculated for each activity. Total float is the full amount of time by which the start on an activity may be delayed without causing the project to last longer.

g. ACTIVITY CALENDARS - The appropriate calendar assignment shall be made to each activity

h. ACTIVITY CODES - Coding shall be assigned to each activity from the defined activity dictionary. Each code shall have a value assigned in a given activity.

i. ACTIVITY CONSTRAINTS - The start or completion of any activity shall not be constrained. Exceptions to this must receive prior approval in writing by the Engineer. A "Must¬ Finish-By" Date for the overall project is a constraint and must be pre-approved by the Engineer.

j. ACTIVITY RESOURCE S- The schedule shall be "Resource" loaded as required by the Engineer. The resources required to accomplish each activity shall be assigned to that activity from the 'Resource Dictionary"

6. REQUIRED ACTIVITIES - The following activities shall be incorporated into the Schedule:

Activity ID	Activity Description	Activity Type	Logic Relationship
000010	Contract "Notice to Proceed"	Start Milestone	No Predecessors to this First Schedule Activity
999999	Completion	Finish Milestone	No Successors to this Last Schedule Activity

7. DATA DATE - The Data Date and Project Start Date in the Initial Baseline Schedule shall be the NOTICE TO PROCEED DATE. The Data Date for each Monthly Update shall be the last work day of the month.

D. REVIEW AND ACCEPTANCE OF THE INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. The Contractor shall submit to the Engineer the following items to facilitate review of the Initial Baseline CPM Construction Schedule:

   a. Narrative - A statement explaining the general sequence of work in the Contractor's schedule, a detailed definition of the work on the Critical Path, a statement regarding the meeting of any Time Restrictive Clause dates, and the explanation of any other ambiguities in the schedule.

2. The following Activity Sorts generated from the software shall be provided or as required and approved by the Engineer:

   a. Critical Path Activity Sort - The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
   b. Time Related Activity Sort - For the activities necessary to complete the work within each specific Time Frame provision in the contract, shall be listed. The list shall start with the first milestone activity and then ascend by Early Start date to the final milestone activity in the network comprising each Time Frame period. Include a Critical Path activity sort for each specific Time Frame in the contract.
   c. Constraint Activity Sort - Listing of Constrained Activities and type of constraint.
   d. Listing of Calendars and Activity Coding incorporated in the Schedule

3. Electronic copies of the Initial CPM Construction Schedule shall be provided in format approved by the Engineer.

4. The Engineer will review the Initial Baseline CPM Construction Schedule and forward any comments, revisions, or requests to the Contractor. Within ten (10)

work days of the Engineer's reply, the Contractor shall make adjustment to the Initial Baseline CPM Construction Schedule in accordance with the Engineer's comments and resubmit copies for review consistent with the above directives.

5. Upon final revisions, the Contractor shall submit electronic file copies of the Initial Baseline CPM Construction Schedule to the Engineer. A sort of activities scheduled to start (ES) & finish (EF) in the next update period shall be included. The Logic Diagram shall be submitted as directed by the Engineer. The final submission shall be submitted for approval within five (5) work days of the Contractor's receipt of the final comments by the Engineer.

6. Approval of the Initial Baseline CPM Construction Schedule by the Engineer shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee completion of the project in accordance with the contract proposal, plans, and specifications. Approval shall not be construed to modify or amend the completion date. Completion dates can only be modified or amended by standard contractual means.

7. Failure to include in the Initial Baseline CPM Construction Schedule any element of work required for the performance of the contract shall not excuse the Contractor from completing all work required within the completion date(s) specified in the contract.

E. SCHEDULE UPDATES

1. MONTHLY PROGRESS UPDATES
The Contractor shall update the schedule monthly. The schedule shall be updated to include all work and progress up to and including the last working day of the month. This will establish the "Data Date". The Monthly update shall detail progress based on actual dates of activities started and completed, the percent of work completed to date on each activity started but not yet completed and the status of procurement of critical materials. The updated schedule data shall be submitted in an electronic file format acceptable to the Engineer.

2. A Narrative Report is required for each update and shall provide the following information:

- Contractor's transmittal letter to the Engineer stating the update period and schedule "Data Date".
- Work started, completed and ongoing during the update period by activity with "Actual Dates".
- Description of current Critical Path and any change from previous Critical Path.
- Any activities added or deleted and any proposed changes in Activity Logic (Engineer's approval in writing is required).
- Current Delays or Advancements

- Delayed or Advanced Activities.
- Proposed corrective action and schedule adjustments to address the Delay.
- Impact of Delay or Advancement on other activities (duration, ES,EF,LS,LF), milestone and completion dates.
- Impact of Delay or Advancement on the Critical Path.

- Outstanding Items that effect the schedule and status thereof (including but not limited to):
  - Permits.
  - Shop Drawings.
  - Change Orders.
  - Reviews of submittals.
  - Approvals.
  - Fabrication and Delivery.
- Scheduled Completion Date Status
  - Contract Completion.
  - Interim Time Frame if any.

3. The following Activity Sorts generated from the Software shall be provided:
   - Current Critical Path Activity Sort
   - Near Critical Activities Sort
   - Sort of Activities scheduled to start (ES) & finish (EF) in the next Monthly update period.
   - Any other "sort" as directed by the Engineer and/or as discussed in the pre-construction scheduling meeting.

4. The Monthly Progress Updates shall be submitted to the Engineer within five (5) work days of the "Data Date". The Engineer shall prepare a written response within five (5) work days of receipt of the Monthly Update approving, approving with comments, or returning for resubmission within five (5) work days. **If the Contractor fails to comply with the Monthly Progress Update submission requirements the Commissioner reserves the right to withhold any or all contract payments.**

F. TOTAL FLOAT OWNERSHIP

Total Float belongs to the contract and shall not be considered as available for the exclusive use or benefit of either the County or the Contractor. Total Float is the number of days an activity may be delayed without extending the completion of either the project or an interim milestone. Float is available on a first-come, first-served basis to all identified "Responsible" parties in the schedule.

G. FLOAT MANIPULATION NOT PERMITTED

The Schedule shall not sequester float through such strategies as calendar manipulation, resource/labor manipulation or the extension of activity durations to fill up available float time. The Initial Baseline CPM Construction Schedule shall not attribute negative float to any activity.

H. CHANGES TO THE SCHEDULE

The Initial Baseline CPM Construction Schedule shall accurately reflect the manner in which the Contractor intends to proceed with the project. Changes to the schedule (the addition or deletion of activities, logic changes, and duration changes) shall be submitted in writing to the Engineer for approval and inclusion in the next Monthly Progress Update. The process of comparing the Schedule Update to Baseline shall be followed throughout the contract. Revision to any contract milestones, or contractually mandated schedule provisions will not be permitted without written authorization from the Engineer.

I. CRITICAL ACTIVITIES AND BASIS FOR TIME ADJUSTMENTS

The measure for Time Adjustments in the schedule shall be based on the criticality, and responsibility of the delay or advancement. Criticality is defined as the presence of the delayed or advanced activity on the projects Critical Path. The Critical Path is defined to be the longest continuous chain of activities through the schedule network that establishes the minimum overall duration in the absence of constraints in the program software. Time adjustment does not mean an extension of time for this contract.

J. CHANGES TO THE CONTRACT

In the event a notice of a change to the contract is received the Contractor shall notify the Engineer in writing within 10 (ten) calendar days of the effect of such change to the schedule. Change to the contract includes, but is not limited to, extra work, change orders, work suspensions, changed condition, Value Engineering Change Proposal, etc. The effect of the change to the contract on the projects Critical Path shall be stated. Any proposed revisions to the Schedule to incorporate the change to the contract shall be stated. No changes shall be made to the Schedule without prior written approval of the Engineer. The approved changes shall be incorporated in the next Monthly Progress Update.

1.3 TIME IMPACT ANALYSIS

A. This analysis will be performed by the Engineer (CM's scheduler) based on schedule updates as accepted in monthly schedule meetings.

B. Events, actions, and progress that cause delays or gains to the Project Schedule will be analyzed solely by the "Contemporaneous Period Analysis" method. The Contemporaneous Period Analysis evaluates delays or gains in the period in which it occurred. The analysis period for the purpose of this Specification shall be the period covered in each Monthly update to the schedule.

C. Impact of delay will be evaluated at the completion of the project. However an interim extension of time for payment purposes only may be granted by the Commissioner at his or her sole discretion at the end of contractual completion date.

1.4 RECOVERY SCHEDULES

A. General Provisions for Recovery Schedules

1. When updated Progress Schedule indicates and the Engineer determines that the ability to comply with the Contract Times falls behind schedule due to delay attributed to the CONTRACTORS, General Contractor shall prepare and submit a Progress Schedule demonstrating responsible Contractor's plan to accelerate related work to achieve compliance with the Contract Times ("recovery schedule") for Engineer's acceptance.

2. When recovery schedule will affect another prime Contractor on the Project, input on proposed recovery schedule action from the responsible prime Contractors must be provided within 10 work days of such determination by the Engineer. Incorporate requirements of other prime Contractors into the recovery schedule to the extent applicable.

3. Submit recovery schedule within 10 work days after submittal of updated Progress Schedule where need for recovery schedule is indicated or include in next update as directed by the Engineer.

B. Implementation of Recovery Schedule

1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.

2. Item 1 above is also applicable when prime Contractor is required to accelerate their Work to recover lost time.

3. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action

1. Prime Contractor's refusal, failure, or neglect to take appropriate recovery action, or General Contractor's refusal to submit a recovery schedule and take appropriate recovery action, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

1.5 METHOD OF MEASUREMENT

The CPM (Critical Path Method) Progress Schedule will be measured for payment on a Lump Sum Basis.

1.6 BASIS OF PAYMENT

The lump sum price bid for the Critical Path Method Scheduling system shall include the cost of preparation and submission of the Initial Baseline Schedule and the preparation and submission of the monthly updates.

Payment will be made as follows:

A.	Upon submission of the Initial Baseline CPM Construction Schedule	20%
B.	Upon acceptance of the Baseline CPM Construction Schedule	20%
C.	The balance will be paid in equal monthly payments distributed over the contract. These payments will be contingent on the submission of acceptable monthly updates,	60%

D. No additional payment over and above the lump sum price bid will be made for addition or deletion of work, delays, or any other reason whatsoever.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 013200

SECTION 01 32 13 CPM (CRITICAL PATH METHOD) PROGRESS SCHEDULE (SINGLE PRIME)

PART 1 -GENERAL

1.01 DESCRIPTION

A. The work shall consist of preparing, submitting, and maintaining a computerized CPM (Critical Path Method) progress schedule using Primavera P6 software.
B. The purpose of the computerized CPM progress schedule is to ensure timely completion of the contract and to establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of Scheduling.
C. For this specification, “Engineer” means County authorized Construction Manager.
D. The Contractor shall ensure that any and all computer files submitted to the Engineer are in a format that can be imported directly using Primavera software, version P6 (or as approved by the Engineer).

1.02 DETAILS

A. PRE-CONSTRUCTION SCHEDULE MEETING
   1. The Engineer will schedule and conduct a Pre-construction Scheduling Meeting with the Contractor within ten (10) working days after the contract has been awarded. The requirements of this specification will be reviewed at this meeting. Additionally, the following topics will be discussed:
      a. Specifics of any contract Time-Related Clauses.
      b. The representation in the schedule of the Time Related work.
      c. The calendar, activity coding, and resource definition requirements unique to and consistent with the contract.
      d. The Contractor’s schedule methodology employed, proposed work sequence and any proposed deviations of sequences from the contract plans.
      e. The factors that the Contractor determines to control the completion of the project and any milestone completions contained therein.
      f. Narrative content for Initial Baseline and Monthly Updates.
      g. Schedule submission protocol for Initial Baseline and Monthly Updates.
      h. The Contractors attendance at the Pre-construction Scheduling Meeting is mandatory. No fieldwork will be allowed, with the exception of set up of the field office, until this meeting is held.

B. INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. Within fifteen (15) workdays following the Notice to Proceed, the Contractor shall prepare and submit to the Engineer the Initial Baseline CPM Construction Schedule for the entire project. This submission shall include the electronic Schedule file and paper reports as required and approved by the Engineer.
2. The Initial Baseline Schedule must be cost and resource loaded and shall represent the Contractor's plan to construct the project. This schedule shall include all work and activities necessary to complete the project including but not limited to activities for the preparation, submittal, review, approval, fabrication, and delivery of all shop drawing and procurement related items. The Initial Baseline CPM Construction Schedule must be set up to conform to the staging/phasing and other requirements defined in the contract.
3. The Initial Baseline Schedule shall meet all interim milestone dates and shall not extend beyond the contract completion date.

C. SCHEDULE REQUIREMENTS
1. The Contractors Initial Baseline CPM Construction Schedule shall meet the following requirements:
2. CPM ACTIVITY NETWORK FORMAT - The schedule network shall use the Precedence Diagraming Method. (If the contractor desires to employ an alternative method prior approval by the Engineer is required and no changes to the initial submission date will be permitted.)
3. PROJECT DEFINITIONS - The following project specific properties within the schedule shall be defined:
    a. CALENDAR - All calendars created shall encompass and account for the total duration of the contract time period. The standard calendar shall be 8-hour days, five days per week and shall account for holidays and non-working days. Additional calendars shall be created and included as required for:
        1) Work week (5 or 6 day). (When or if the contractor elects to utilize a 6 day work week he shall be responsible for the county's overtime costs as applicable by the contract requirements).
        2) Seasonal restrictions (asphalt, landscape, etc.).
        3) Concrete curing/calendar days.
        4) Shop drawing review.
        5) Any project specifics as required by the Engineer.
        6) Expected and contemplated weather conditions shall be accounted for in the calendars.
    b. ACTIVITY CODE - As a minimum, the following activity codes shall be established:

1) Responsibility -The party responsible for each activity. Only one party can be responsible for an activity. Include Values for “Nassau County Department of Public Works (NC)”, “Prime Contractor” and third parties to the contract as appropriate (utilities, etc.).
2) Phase - Phasing consistent with Contract plans where each activity is performed; Include Values for “None”, and “Project Wide”.
3) Location - Location of activity work by Stationing; Include Value for “None”, and “Project Wide”
4) Type - The type of work for each activity; Include a Value for Administrative.”
5) Added Work - Work added to the Contract and incorporated into the schedule with the Engineers Approval.
6) As Required by Project - Any coding unique to or as required by the Engineer to facilitate the use and analysis of the Schedule. This coding shall be established in consultation with the Engineer at the Pre-construction Scheduling Meeting.

4. RESOURCES - The Resource Dictionary shall be established as required by the Engineer. The Resource Dictionary shall be limited to Labor and Equipment. Labor may be represented by work crews. The composition of each crew must be detailed and included as an appendix to the Narrative Report. Sub-Contractors shall be represented as a labor crew(s).
5. COST LOADING – Basis of cost loading will be the **approved** bid breakdown.
6. ACTIVITY DATA
   a. ACTIVITY IDENTIFICATION - Each activity shall have a unique identifier. The identifier may be alpha-numeric, but at a minimum must be a unique number.
   b. ACTIVITY DESCRIPTION - Each activity shall be unambiguously described. Descriptions such as "construct 30% of Y” are unacceptable. Activities shall be discrete to the extent necessary to accurately schedule the work.
   c. ACTIVITY DURATION - Durations of individual work activities shall not exceed fifteen working days. The minimum activity duration increment is one full day. Durations of individual shop drawing review activities may exceed fifteen working days and shall be consistent with Contract Requirements. Exceptions to this will be reviewed by the Engineer on an activity-by-activity basis. If requested by the Engineer, production rates or other supporting information shall be supplied justifying the reasonableness of any given activity time duration. A Method Statement including the labor, equipment, production rates and any additional information, required to achieve a given activity shall be supplied within 5 working days when requested by the Engineer.

d. ACTIVITY RELATIONSHIPS - Activity relationships shall be finish-to-start with no lags unless directed otherwise by the Engineer. Contractor requests for exemptions will be made on a case by case basis. Each activity with the exception of the required "Project Award" and "Completion" activities shall have a predecessor and a successor activity relationship.
e. ACTIVITY START and FINISH DATES - The earliest start date, earliest finish date, latest start date, and latest finish date shall be calculated for each activity.
f. ACTIVITY TOTAL FLOAT - The total float shall be calculated for each activity. Total float is the full amount of time by which the start on an activity may be delayed without causing the project to last longer.
g. ACTIVITY CALENDARS - The appropriate calendar assignment shall be made to each activity
h. ACTIVITY CODES - Coding shall be assigned to each activity from the defined activity dictionary. Each code shall have a value assigned in a given activity.
i. ACTIVITY CONSTRAINTS - The start or completion of any activity shall not be constrained. Exceptions to this must receive prior approval in writing by the Engineer. A "Must-Finish-By" Date for the overall project is a constraint and must be pre-approved by the Engineer.
j. ACTIVITY RESOURCE(S) - The schedule shall be "Resource" loaded as required by the Engineer. The resources required to accomplish each activity shall be assigned to that activity from the 'Resource Dictionary"

7. REQUIRED ACTIVITIES -The following activities shall be incorporated into the Schedule:

Activity ID	Activity Description	Activity Type	Logic Relationship
000010	Contract "Notice to Proceed"	Start Milestone	No Predecessors to this First Schedule Activity
999999	Completion	Finish Milestone	No Successors to this Last Schedule Activity

8. DATA DATE - The Data Date and Project Start Date in the Initial Baseline Schedule shall be the NOTICE TO PROCEED DATE. The Data Date for each Monthly Update shall be the last workday of the month.

D. REVIEW AND ACCEPTANCE OF THE INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. The Contractor shall submit to the Engineer the following items to facilitate review of the Initial Baseline CPM Construction Schedule:
   a. Narrative -A statement explaining the general sequence of work in the Contractor's schedule, a detailed definition of the work on the Critical Path, a statement regarding the meeting of any Time Restrictive Clause dates, and the explanation of any other ambiguities in the schedule.
2. The following Activity Sorts generated from the software shall be provided or as required and approved by the Engineer:
   a. Critical Path Activity Sort -The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
   b. Time Related Activity Sort -For the activities necessary to complete the work within each specific Time Frame provision in the contract, shall be listed. The list shall start with the first milestone activity and then ascend by Early Start date to the final milestone activity in the network comprising each Time Frame period. Include a Critical Path activity sort for each specific Time Frame in the contract.
   c. Constraint Activity Sort -Listing of Constrained Activities and type of constraint.
   d. Listing of Calendars and Activity Coding incorporated in the Schedule
3. Electronic copies of the Initial CPM Construction Schedule shall be provided in format approved by the Engineer.
4. The Engineer will review the Initial Baseline CPM Construction Schedule and forward any comments, revisions, or requests to the Contractor. Within ten (10) workdays of the Engineer’s reply, the Contractor shall make adjustment to the Initial Baseline CPM Construction Schedule in accordance with the Engineer’s comments and resubmit copies for review consistent with the above directives.
5. Upon final revisions, the Contractor shall submit electronic file copies of the Initial Baseline CPM Construction Schedule to the Engineer. The sort of activities scheduled to start (ES) & finish (EF) in the next update period shall be included. The Logic Diagram shall be submitted as directed by the Engineer. The final submission shall be submitted for approval within five (5) workdays of the Contractor’s receipt of the final comments by the Engineer.
6. Approval of the Initial Baseline CPM Construction Schedule by the Engineer shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee completion of the project in accordance with the contract proposal, plans, and specifications. Approval shall not be construed to modify or amend the completion date. Completion dates can only be modified or amended by standard contractual means.

7. Failure to include in the Initial Baseline CPM Construction Schedule any element of work required for the performance of the contract shall not excuse the Contractor from completing all work required within the completion date(s) specified in the contract.

E. SCHEDULE UPDATES

1. MONTHLY PROGRESS UPDATES The Contractor shall update the schedule monthly. The schedule shall be updated to include all work and progress up to and including the last working day of the month. This will establish the “Data Date”. The Monthly update shall detail progress based on actual dates of activities started and completed, the percent of work completed to date on each activity started but not yet completed and the status of procurement of critical materials. The updated schedule data shall be submitted in an electronic file format acceptable to the Engineer.
2. A Narrative Report is required for each update and shall provide the following information:
   - Contractors transmittal letter to the Engineer stating the update period and schedule "Data Date".
   - Work started, completed and ongoing during the update period by activity with “Actual Dates”.
   - Description of current Critical Path and any change from previous Critical Path.
   - Any activities added or deleted and any proposed changes in Activity Logic (Engineer’s approval in writing is required).
   - Current Delays or Advancements
     - Delayed or Advanced Activities.
     - Proposed corrective action and schedule adjustments to address the Delay.
     - Impact of Delay or Advancement on other activities (duration, ES, EF, LS, LF), milestone and completion dates.
     - Impact of Delay or Advancement on the Critical Path.
   - Outstanding Items that effect the schedule and status thereof (including but not limited to):
     - Permits.
     - Shop Drawings.
     - Change Orders.
     - Reviews of submittals.
     - Approvals.
     - Fabrication and Delivery.
   - Scheduled Completion Date Status
     - Contract Completion.
     - Interim Time Frame if any.

3. The following Activity Sorts generated from the Software shall be provided:
   - Current Critical Path Activity Sort
   - Near Critical Activities Sort
   - Sort of Activities scheduled to start (ES) & finish (EF) in the next Monthly update period.
   - Any other "sort" as directed by the Engineer and/or as discussed in the pre-construction scheduling meeting.
4. The Monthly Progress Updates shall be submitted to the Engineer within five (5) workdays of the "Data Date". The Engineer shall prepare a written response within five (5) workdays of receipt of the Monthly Update approving, approving with comments, or returning for resubmission within five (5) workdays. **If the Contractor fails to comply with the Monthly Progress Update submission requirements the Commissioner reserves the right to withhold any or all contract payments.**

F. TOTAL FLOAT OWNERSHIP Total Float belongs to the contract and shall not be considered as available for the exclusive use or benefit of either the County or the Contractor. Total Float is the number of days an activity may be delayed without extending the completion of either the project or an interim milestone. Float is available on a first-come, first-served basis to all identified "Responsible" parties in the schedule.

G. FLOAT MANIPULATION NOT PERMITTED The Schedule shall not sequester float through such strategies as calendar manipulation, resource/labor manipulation or the extension of activity durations to fill up available float time. The Initial Baseline CPM Construction Schedule shall not attribute negative float to any activity.

H. CHANGES TO THE SCHEDULE The Initial Baseline CPM Construction Schedule shall accurately reflect the manner in which the Contractor intends to proceed with the project. Changes to the schedule (the addition or deletion of activities, logic changes, and duration changes) shall be submitted in writing to the Engineer for approval and inclusion in the next Monthly Progress Update. The process of comparing the Schedule Update to Baseline shall be followed throughout the contract. Revision to any contract milestones, or contractually mandated schedule provisions will not be permitted without written authorization from the Engineer.

I. CRITICAL ACTIVITIES AND BASIS FOR TIME ADJUSTMENTS The measure for Time Adjustments in the schedule shall be based on the criticality, and responsibility of the delay or advancement. Criticality is defined as the presence of the delayed or advanced activity on the projects Critical Path. The Critical Path is defined to be the longest continuous chain of activities through the schedule network that establishes the minimum overall duration in the absence of constraints in the program software. Time adjustment does not mean an extension of time for this contract.

J. CHANGES TO THE CONTRACT In the event a notice of a change to the contract is received the Contractor shall notify the Engineer in writing within 10 (ten) calendar days of the effect of such change to the schedule. Change to the contract includes, but is not limited to, extra work, change orders, work suspensions, changed condition, Value Engineering Change Proposal, etc. The effect of the change to the contract on the projects Critical Path shall be stated. Any proposed revisions to the Schedule to incorporate the change to the contract shall be stated. No changes shall be made to the Schedule without prior written approval of the Engineer. The approved changes shall be incorporated in the next Monthly Progress Update.

1.03 TIME IMPACT ANALYSIS

A. This analysis will be performed by the Engineer (CM's scheduler) based on schedule updates as accepted in monthly schedule meetings.
B. Events, actions, and progress that cause delays or gains to the Project Schedule will be analyzed solely by the "Contemporaneous Period Analysis" method. The Contemporaneous Period Analysis evaluates delays or gains in the period in which it occurred. The analysis period for the purpose of this Specification shall be the period covered in each Monthly update to the schedule.

C. Impact of delay will be evaluated at the completion of the project. However, an interim extension of time for payment purposes only may be granted by the Commissioner at his or her sole discretion at the end of contractual completion date.

1.04 RECOVERY SCHEDULES

A. General Provisions for Recovery Schedules
   1. When updated Progress Schedule indicates and the Engineer determines that the ability to comply with the Contract Times falls behind schedule due to delay attributed to the CONTRACTORS, General Contractor shall prepare and submit a Progress Schedule demonstrating responsible Contractor's plan to accelerate related work to achieve compliance with the Contract Times ("recovery schedule") for Engineer's acceptance.
   2. When recovery schedule will affect another prime Contractor on the Project, input on proposed recovery schedule action from the responsible prime Contractors must be provided within 10 workdays of such determination by the Engineer. Incorporate requirements of other prime Contractors into the recovery schedule to the extent applicable.
   3. Submit recovery schedule within 10 workdays after submittal of updated Progress Schedule where need for recovery schedule is indicated or include in next update as directed by the Engineer.

B. Implementation of Recovery Schedule
   1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
   2. Item 1 above is also applicable when prime Contractor is required to accelerate their Work to recover lost time.
   3. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action
   1. Prime Contractor's refusal, failure, or neglect to take appropriate recovery action, or General Contractor's refusal to submit a recovery schedule and take appropriate recovery action, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

1.05 METHOD OF MEASUREMENT

A. The CPM (Critical Path Method) Progress Schedule will be measured for payment on a Lump Sum Basis.

1.06 BASIS OF PAYMENT

A. The lump sum price bid for the Critical Path Method Scheduling system shall include the cost of preparation and submission of the Initial Baseline Schedule and the preparation and submission of the monthly updates.
B. Payment will be made as follows:
   1. Upon submission of the Initial Baseline CPM Construction Schedule 20%
   2. Upon acceptance of the Baseline CPM Construction Schedule 20%
   3. The balance will be paid in equal monthly payments distributed over 60%
   4. the contract. These payments will be contingent on the submission of
   5. acceptable monthly updates,
   6. No additional payment over and above the lump sum price bid will be made for addition or deletion of work, delays, or any other reason whatsoever.

PART 2 -PRODUCTS (NOT USED)

PART 3 -EXECUTION (NOT USED)

END OF SECTION 01 32 13

SAFE AND HEALTHFUL WORKING CONDITIONS
SECTION 01 35 60

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the requirements for safe and healthful working conditions as an integral part of the project construction.

1.02 DEFINITION

A. Safety staff shall mean the safety professional and his/her safety representative(s) or the safety person.

1.03 GENERAL REQUIREMENTS

A. In prosecuting the work of this Contract, the Contractor shall provide working conditions on each operation that shall be as safe and healthful as the nature of that operation permits. The various operations connected with the work shall be so conducted that they will not be unsafe or injurious to health; and the Contractor shall comply with all regulations and published recommendations of the New York State Department of Labor and all provisions, regulations and recommendations issued pursuant to the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and with laws, rules, and regulations of other authorities having jurisdiction, with regard to all matters relating to safe and healthful working conditions.

1. Compliance with governmental requirements is mandated by law and considered only a minimum level of safety performance.

2. All work shall also be performed in accordance with safe work practice, and contractor's Health and Safety Plan, as approved by the Construction Manager in writing.

B. The Contractor shall be responsible for the safety of the Contractor's employees, the public, and all other persons at or about the site of the work. The Contractor shall be solely responsible for the adequacy and safety of all construction methods, materials, equipment, and the safe prosecution of the work.

C. The Contractor shall employ a properly qualified safety professional familiar with all work under this contract whose duties shall be to initiate, review, and cause implementation of measures for the protection of health and prevention of accidents.

D. The safety staff shall be provided with an appropriate office on the job site to maintain and keep available safety records, up-to-date copies of all pertinent safety rules, regulations and governing legislation, material safety data sheets, and the site safety plan including information concerning foreseeable emergency conditions, location of emergency and telephone contacts for supportive actions.

E. The Contractor shall stop work whenever a work procedure or a condition at a work site is deemed unsafe by the safety staff.

1.04 SUBMITTALS

A. The Contractor shall submit a Health and Safety Plan (HASP), prepared prior to the start of any construction for acceptance by the CM, in writing.

1. The HASP shall be available to workers on site and be submitted to the Engineer and Owner at least two (2) weeks before the beginning of any field work.

2. Copies of the plan shall be provided to the Contractors' insurers and their risk managers, if any, by the Contractor.

B. Within thirty (30) days of receiving a "Notice to Proceed", the Contractor shall submit the name of a safety professional, employed by the Contractor, responsible for project safety management, and of the safety representative(s) who will work under his/her direction.

C. Documentation and/or personal references confirming the qualifications may also be required.

1. The persons proposed as a safety person, safety professional, or safety representative(s), may be rejected by the Engineer for failure to have adequate qualifications or other cause.

D. In addition, the Contractor shall submit the names, addresses, and telephone numbers of three (3) supervisory personnel who may be contacted in the event of an emergency occurring during non-working hours.

1.05 QUALIFICATIONS

A. Safety Professional:

1. Certification by the Board of Certified Safety Professional as a Certified Safety Professional.

2. Minimum of five (5) years of professional safety management experience in the types of construction and conditions expected to be encountered on the site.

B. Safety Person:

1. Qualifications of the safety person must include a minimum of five (5) years of relevant construction experience, two (2) years of which are related to safety management.

C. The Safety staff shall be completely experienced with OSHA requirements and knowledgeable of all applicable health and safety requirements of all governing laws, rules and regulations as well as of good safety practice. The safety staff shall not include the project manager, engineer, or superintendent, or anyone else working on the project. The safety staff shall have no other duties except those directly related to safety.

PART 2 PRODUCTS

2.01 HEALTH AND SAFETY PLAN

A. The Contractor shall commit to writing a specific site Health and Safety Plan before the start of any construction for acceptance by the Construction Manager.

2.02 ACCIDENT REPORTS

A. The Contractor shall promptly (within the hour of the incident) report to the Construction Manger all accidents involving injury to personnel or damage to equipment and structures, investigate these accidents and prepare a preliminary report and submit within twenty-four (24) hours of the accident. The Contractor must submit a final accident report to the Construction Manager as follows:

1. The summary report, due by the tenth (10^{th}) day of the incident, shall include descriptions of corrective actions to reduce the probability of similar accidents.

2. In addition, the Contractor shall furnish to the Engineer, a copy of all accident and health or safety hazard reports received from OSHA or any other government agency, within one (1) day of receipt, and attach the final plan.

B. In addition to the reports which the Contractor is required to file under the provisions of the Workman's Compensation Law, he/she shall submit to the Engineer on or before the tenth (10^{th}) day of each month, a report giving the total force employed on his/her Contract in man-days during the previous calendar month, the number and character of all accidents resulting in loss of time or considered reportable by OSHA, and any other information on classification of employees, injuries received on the work, and disabilities arising therefrom, that may be required by the Engineer.

1. The submittal shall also contain an audit report for the prior month, including the safety training conducted, the above equipment logs, records of the condition of the work areas, safety and health records, OSHA and ANSI Z16.1 incidence rates for frequency and severity of recordable accidents, and an evaluation of the effectiveness of the HASP with any changes necessary.

2. The safety professional or safety person and the Contractor shall sign this audit report. The Engineer will review these reports for Contractor's compliance with the safety provisions of the Contract.

2.03 SAFETY AND RESCUE EQUIPMENT

A. The Contractor shall have proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency. This equipment shall include such applicable items as: proper fire extinguishers, first aid supplies, safety ropes and harness, stretchers, water safety devices, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, combustible gas detectors, etc.

B. This equipment shall be kept in a protected area and checked at scheduled intervals. A log shall be maintained indicating who checked the equipment, when it was checked, and that it was acceptable. This equipment log shall be updated monthly and be submitted with the

monthly report. Equipment that requires calibration shall have copies of dated calibration certificates on site.

C. Substitute safety and rescue equipment must be provided while primary equipment is being serviced or calibrated.

2.04 PROTECTIVE EQUIPMENT

A. All personnel employed by the Contractor or his subcontractors or any visitors whenever entering the job site shall be required to wear appropriate personal protection equipment required for that area. The Contractor shall provide all necessary personal protective equipment as requested by the Engineer for his/her designated representatives.

PART 3 EXECUTION

3.01 SAFETY STAFF DUTIES

A. The safety professional shall visit and audit all work areas as frequently as necessary (a minimum of once a week) and shall be available for consultation whenever necessary. The safety staff shall have full authority to implement and enforce the Health and Safety Plan to take immediate action to correct unsafe, hazardous, or unhealthful conditions.

B. A member of the safety staff must be at the job site full time (a minimum of eight (8) hours per working day) whenever work is in progress. When multiple shift work is in progress, more than one (1) safety representative may be required. The safety staff shall as a minimum:

1. Schedule safety training programs as required by law, the safety plan, and good safety practice. An outline of materials to be covered shall be provided with the safety plan. All employees shall be instructed on the recognition of hazards, observance of precautions, of the contents of the safety plan and the use of protective and emergency equipment.

2. Determine that operators of specific equipment are qualified by training and/or experience before they are allowed to operate such equipment.

3. Develop and implement emergency response procedures. Post the name, address, and hours of the nearest medical doctor; name and address of nearby clinics and hospitals, and the telephone numbers of the appropriate ambulance service, fire, and the police department.

4. Post all appropriate notices regarding safety and health regulations at locations which afford maximum exposure to all personnel at the job site.

5. Post appropriate instructions and warning signs in regard to all hazardous areas or conditions which cannot be eliminated. Identification of these areas shall be based on experience, on site surveillance, and severity of hazard. Such signs shall not be used in place of appropriate workplace controls. In order to alert the workers “Safety First” signs should be posted, as ordered by the Engineer at no extra cost.

6. Ascertain by personal inspection that all safety rules and regulations are enforced. Make inspections at least once a shift to ensure that all machines, tools, and equipment are in a safe operating condition, and that all work areas are free of hazards. Take necessary and timely corrective actions to eliminate all unsafe acts and/or conditions, and submit to the Engineer each day, a copy of his/her findings on the inspection check list report forms established in the safety plan.

7. Submit to the Engineer, copies of all safety inspection reports and citations from regulating agencies and insurance companies within one (1) workday of receipt of such reports.

8. Provide safety training and orientation to authorized visitors to ensure their safety while occupying the job site.

9. Perform all related tasks necessary to achieve the highest degree of safety that the nature of the work permits.

3.02 MEASUREMENT OF PAYMENT

A. No separate payment for the article "Safe and Healthful Working Conditions" will be made. The costs of same will be included in the Lump Sum Bid.

END OF SECTION 01 35 60

SECTION 014339 - MOCK-UPS

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 SUMMARY

A. General: The requirements of this Section are of a procedural and administrative nature relative to products, materials, equipment, substitutions, and options as described herein and in other sections of the specifications.

B. Mock-Up Assemblies: Models built accurately using full scale materials for the purpose of study, testing, display, material and methods approval and final approval.

1. Provide submittals and all labor, materials, equipment and services required for the approval of samples, Mock-Up Construction and removal of Work at the end of the project and after final approval, at no additional cost to the Architect or Owner.

C. Product List Schedule: A list of each product required and coordinated with the Contractor's Construction Schedule and the Schedule of Submittals.

1.3 DEFINITIONS

A. General: Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

B. Products: "Products" includes purchased items for incorporation into the project, whether purchased for the project or taken from previously purchased stock. The term "product" includes "material," "equipment," "system," and terms of similar intent.

1. "Named" products are those items identified by manufacturer's name, and product name, including make or model designation in the manufacturer's product literature, that is current as of the date of the Contract Documents.

C. Materials: Items which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form a part of the work.

D. Equipment: Products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections such as wiring, piping, etc.

E. Materials mock-ups (M) are intended for review of materials, components and to set standards of workmanship for all portions of assemblies demonstrated. Approval is required prior to release for purchase of materials and/or fabrication, as may be applicable. Mock-ups may or may not be incorporated into the work, as applicable.

F. Installation mock-ups (I) are intended for review and to set standards of workmanship for all portions of assemblies demonstrated. Installation mock-ups are provided "in place" and may be incorporated into the work with the approval of the architect(s).

G. Samples (S) are large-size samples, to be reviewed on site.

1.4 MOCK-UP CONSTRUCTION

A. Schedule: A time schedule for the construction of all mock-up assemblies shall be prepared by the Contractor and submitted to the Architect for review, prior to the start of construction. Incorporate Mock-Up Schedule into Construction and Submittal Schedules.

B. Shop Drawings: Prepare and submit shop drawings of each mock-up assembly for review by the Architect. Shop drawings shall indicate all details, dimensions, connections, tolerances, and the relationship of the various parts to each other and to adjoining work.

C. Samples and Product Data: Prior to delivery of materials for mock-up assemblies, submit product data and samples of all materials proposed for use in the construction of the mock-ups for review by the Architect. Samples shall illustrate all characteristics such as scale, color and texture of finishes, sizes, shapes, and physical properties of the materials to be used in the Work.

D. Construction: Refer to drawings for size and location of mock-ups; mock-up numbers coincide with numbers on drawings. All slabs, footings, supporting walls, frames, etc. required for mock-up construction shall be provided by the Contractor.

E. Sequence of Inspection

1. The Architect shall be notified by the Contractor at the start of building all the mock-up assemblies and shall be sent progress reports to allow the Architect to schedule inspections.

2. Visual examination of all mock-up assemblies will be made by the Architect, Owner, and other interested parties during construction.

3. Mock-ups shall be scheduled well in advance of actual construction of the specified area to allow adjustments in material use, material selections and construction techniques.

4. Should any mock-up assembly fail to receive the approval of the Architect, it shall be taken down or dismantled and rebuilt to the extent necessary or until the Architect's approval has been obtained; at no cost to the Architect or Owner.

5. The rebuilding and completion of any mock-up assembly as necessary to obtain acceptance shall be so timed by the Contractor as to avoid delay in the construction schedule of the project.

6. Obtain the Architect's acceptance of each finished mock-up before commencing the final corresponding work for the project.

7. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals, and the time schedule for construction of mock-ups.

8. Approved interior mock-ups shall be incorporated into the permanent construction.

F. Approvals Required: Before ordering the job requirements of any materials for construction of work of sections or of assemblies requiring mock-ups, the Contractor is advised that he shall obtain approvals of the following:

1. Material(s).

2. Mock-up.

3. Shop Drawings.

4. Method of Installation, including quality standards that pertain.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means which will prevent damage, deterioration, and loss including theft.

1. Control delivery schedules to minimize long-tern storage of products at site and overcrowding of construction spaces. Provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other causes of loss.

2. Deliver products, materials, and equipment to the site in the manufacturer's original sealed containers or other packaging systems; complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

3. Inspect products, materials, and equipment upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

4. Store products, materials, and equipment in a manner that will facilitate inspection and measurement of quantity or counting of units.

5. Store products, materials, and equipment in a manner to avoid significant or permanent deflection, cracking, or failure of the structure and its finishes.

6. Store products, materials, and equipment subject to damage above ground, under cover in stain-proof and weatherproof enclosures; with ventilation adequate to prevent condensation. Protect against splashing.

B. Particular attention shall be paid to the storage of materials that will be exposed to view when construction is completed. The Architect retains the right to reject and require replacement of any product, material and equipment that has, in his judgment, been visually or physically marred during delivery, storage and handling. All removal and replacement costs direct and indirect, including costs caused by the delay in making such correction, shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 MOCK-UPS

A. Materials and finishes shall comply with the requirements specified in the various sections of the specifications and shall match previously submitted and approved samples.

B. Mock-ups shall incorporate all related construction materials and finishes having a visual effect upon the completed work.

PART 3 EXECUTION

3.1 MOCK-UP ASSEMBLIES

A. General: Mock-up assemblies shall be constructed in accordance with details indicated in the Contract Documents and the following:

1. Site exterior wall mock-up, partial installation to remain when reviewed and approved, as marked up in the Building Elevations.

2. Mock-up of wall and floor installation in the toilet room, partial installation to remain when reviewed and approved, as directed by the Architect.

B. All mock-ups shall be removed and disposed of at the completion of the project. Mockups shall be located in the building so that they can stay erected during the entire construction phase and serve as the quality control sample which all work shall be measured against.

C. Product List Schedule: The Contractor shall prepare a schedule showing products specified in a tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals, and the time schedule for construction of mock-ups.

2. Within 30 days after date of commencement of the Work, submit 4 copies of an Initial Product List Schedule. Provide a written explanation for omissions of data and for known variations from Contract requirements.

3. The Architect will respond with a list of unacceptable product selections and/or requesting more information on certain product selections. Failure of the Architect to list a product unacceptable or not request more information will not constitute a waiver of the requirement to submit a Substitution Request Submittal or waiver of the requirement that products comply with the Contract Documents.

3.2 INSTALLATION OF PRODUCTS

A. Field Measurement: Before ordering any materials or doing any work, the Contractor shall verify all measurements at the project site and shall be responsible for their correctness. Responsibility for dimensions of materials or assemblies shall rest with the Contractor, who shall be responsible to correct to the Architect's approval, or replace, any misfitting elements. No extra charge will be allowed for differences between actual dimensions and measurements indicated on the drawings.

B. Manufacturer's Instructions and Recommendations: Unless more stringent requirements are indicated or specified in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of substantial completion of the Project.

3.3 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for "Cutting and Patching."

B. Protection

1. Protect construction exposed by or for inspection and testing service activities, and protect repaired construction.

2. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION

SECTION 014950

SPILL PREVENTION AND CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK:

This section covers the Contractor's responsibilities with respect for spill prevention and control.

1.02 APPLICABLE REFERENCES:

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to by basic designation only and shall be the latest published versions.

A. United States Environmental Protection Agency (USEPA):

EPA/625/6-B5/006, Remedial Action at Waste Disposal sites

B. Code of Federal Regulations (CFR):

40 CFR Part 300, National Oil and Hazardous Substances Pollution Contingency Plan

40 CFR, Protection of Environment

C. American Society for Testing and Materials (ASTM):

ASTM E119, Fire Resistance Directory

1.03 SUBMITTALS:

A Spill Prevention and Control Plan shall be provided to the Construction Manager, upon request, in accordance with Section 01300: SUBMITTALS

1.04 GENERAL REQUIREMENTS:

1.04.1 The Contractor shall prepare and implement a Spill Prevention and Control Plan and maintain appropriate containment and/or diversionary structure, materials and equipment to prevent and control the maximum spillage of any specific item within the Scope of Work. All materials and equipment used in connection with this project shall be included. The plan shall include inspection and test procedure performed to ensure compliance.

1.04.2 Laws and Regulations: The Contractor shall not pollute any area with any manmade or natural harmful materials. It is the sole responsibility of the Contractor to investigate and comply with all applicable federal, State, County, and municipal laws and regulations concerning the Spill Prevention and Control Plan.

1.04.3 A Project Telephone Directory shall be incorporated into the plan.

1.04.4 Written Discussions: In addition to the minimal prevention standards listed, the Plan shall include a complete discussion of conformance with the following applicable guidelines, other effective spill prevention and containment procedures, or if more stringent, with the State rules, regulations and guidelines.

A. Facility drainage

B. Bulk storage

C. Facility transfer operations, pumping, and conveying materials

D. Truck loading/unloading rack

1.04.5 Design and Specifications: The Contractor shall provide a Spill Prevention and Control Plan with the following designs and specifications:

A. Appropriate containment and/or diversionary structures or equipment to prevent discharge of materials to the environment

B. Dikes sufficiently impervious to contain spill materials

C. Curbing

D. Culverts, gutters, or other drainage systems

E. Weirs, booms, or other barriers

F. Sorbent materials

G. Curbing drip pans

H. Sumps and collection systems

1.04.6 Inspections and Records: Inspections required by this Scope of Work shall be in accordance with written procedures developed for the facility by the Contractor. These written procedures and a record of the inspections, signed by the appropriate supervisor or inspector, shall be part of the Spill Control and Prevention Plan, and shall be maintained during the project and submitted to the Construction Manager for final closeout.

1.04.7 Facility Lighting: Facility lighting shall be commensurate with the type and location of the facility. Consideration shall be given to: 1) Discovery of spills occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel such as security personnel, the general public, local police, etc.; and 2) prevention of spills occurring through acts of vandalism.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 GENERAL:

A. If materials are released, the Contractor shall provide a written description of the event, corrective action taken, and plans for preventing a recurrence, as well as a written commitment of manpower, equipment, and materials required to expedite control and removal of any harmful quantity of materials released.

B. The Contractor shall notify the NYSDEC within two hours of the release or spill. The Contractor shall notify the DEC hotline at 1-800-457-7362.

3.02 TRAINING:

A. Personnel Training and Spill Prevention Procedures: The Contractor shall be responsible for properly instructing his personnel regarding applicable pollution control laws, rules, and regulations; and in the operation and maintenance of equipment to prevent the discharge of materials.

B. Briefings: The Contractor shall schedule and conduct Spill Prevention Briefings for its operating personnel at intervals frequent enough to assure adequate understanding of the Spill Prevention and Control Plan for this project. Such briefings shall highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures.

C. Evacuation Routes: Evacuation Routes shall be marked on the project site.

3.03 TESTING

Facility communication or alarm systems and spill control equipment must be tested and maintained by the Contractor as necessary to assure proper operation in time of emergency.

END OF SECTION 014950

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SECTION 015000 - TEMPORARY CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and to its subcontractors as described herein.

B. Section includes requirements for temporary facilities and services, including utilities, construction and support facilities, security and protection.

C. General Contractor shall provide and pay all costs for the following, as specified in this section:

1. Coordination of location of temporary construction facilities provided by other Contractors.

2. Field office for Architect's, Owner's and Construction manager's use.

3. Drinking water facilities.

4. Fire protection facilities, other than piped utilities.

5. Ice and snow removal.

6. Temporary scaffolding, for construction access into all elevated work areas under construction, from the exterior, for use by all Contractors.

7. Janitorial services and general maintenance of all constructed facilities used by the Contractors during the course of the project.

8. Other employee protection facilities required by law.

9. Temporary toilet/sanitary facilities sufficient for all Contractors and subcontractors; including regular cleaning.

10. Project identification sign.

11. All temporary site fencing, barricades, warning signs and lights as required for facility security.

12. Telephone service, including coin-operated telephones for the use of all trade; locate where directed by the Construction Manager.

13. Temporary enclosures for general building heating and for protection from weather.

14. Temporary stairs.

15. Site cleanup and waste disposal services of all construction debris for all Contractors.

    a. Each Subcontractor is responsible to dispose of their construction debris into

designated dumpsters provided by the General Contractor. The General Contractor will be responsible to dispose of all generated debris to an approved offsite landfill, and ensure dumpsters are continuously available to receive contractor's construction debris. Comply with requirements of Section 01506, Construction Waste Management.

16. Coordination of all construction staging areas at all construction work locations and the coordination of all temporary construction facilities, provided by other Contractors, within all staging areas.

17. Temporary Enclosures for Heating: When general building heating is required for construction operations before completion of building enclosure, provide temporary construction to close openings in building enclosure.

18. Temporary Enclosures for Weather Resistance: When building enclosure is not yet complete but interior construction may be damaged by weather, provide temporary enclosures adequate to keep out weather.

19. Temporary Piping System

    a. Make all arrangements with the proper jurisdictional authorities for connection to its water main. Pay all related costs for the installation therefor.

    b. Furnish and install a complete piping system for the use of temporary water, including a check valve backflow prevention system and a 2 inch valve connection in the temporary water system for each Prime Contractor. Each Contractor shall provide its own hoses, valves and containers as required to service its own work force.

    c. Provide temporary water services at all Work and Phase locations where construction is occurring whether the occurring construction is scheduled or not.

    d. Protect the temporary water piping system from freezing by heat-tracing above-ground piping and installing buried pipes at a minimum depth of 4 feet. The system shall be extended and relocated as necessary to meet construction procedures and temporary water requirements.

    e. Remove all temporary lines when no longer required.

20. Temporary heating at all Work and Phase locations where construction is occurring whether the occurring construction is scheduled or not.

    a. Use of the existing and/or permanent utilities (i.e., water, gas, electricity, etc.) will be permitted subject to the review and approval of the Architect. The absence or unavailability of any or all of the existing or permanent utilities will not relieve the General Contractor from full compliance with the requirements of this section.

    b. Provide heating adequate to maintain a minimum of 65 degrees F, ambient temperature.

    c. Provide heating after the installation of temporary enclosure or as directed by the

Construction Manager.

21. Temporary lighting at all Work, Phase and Staging locations where construction is occurring whether the occurring construction is scheduled or not.

    a. Use of the existing and/or permanent electrical system will be permitted subject to the review and approval of the Construction Manager. The absence or unavailability of any or all of the existing or permanent electrical system will not relieve the General Contractor from full compliance with the requirements of this section.

    b. Provide lighting at the Work and Phase locations adequate to maintain a minimum lighting level of 40fc.

    c. Provide lighting at the Staging locations adequate to maintain a minimum lighting level of 10 fc.

22. Temporary power at all Work, Phase and Staging locations where construction is occurring whether the occurring construction is scheduled or not.

    a. Use of the existing and/or permanent electrical system will be permitted subject to the review and approval of the Construction Manager. The absence or unavailability of any or all of the existing or permanent electrical system will not relieve the General Contractor from full compliance with the requirements of this section.

    b. Provide temporary power at all locations adequate to perform the Work.

    c. Minimum temporary power at all locations shall be 200A, 120/208, 3 Phase, 4 Wire.

3. All temporary service conduit and feeders shall be buried, conform to the local utility company's requirements as to materials and workmanship, and be of sufficient capacity to supply all temporary light and power required for the project.

D. The General Contractor shall provide and pay all costs for all other facilities and services required to accomplish the work.

1.2 DEFINITIONS

A. Temporary Facilities: Construction, fixtures, fittings, and other built items required to accomplish the work but which are not incorporated into the finished work.

B. Temporary Utilities: A type of temporary facility; primary sources of electric power, water, steam supply, natural gas supply, etc., obtained from public utilities, other main distribution systems, or temporary sources constructed for the project, but not including the fixtures and equipment served.

C. Temporary Services: Activities required during construction which do not directly accomplish the work.

D. Construction Equipment: A type of temporary facility, consisting of fixed equipment used to

accomplish the work, determined by the method the Contractor chooses to accomplish the work.

1.3 SUBMITTALS

A. Temporary Utilities: Submit reports of inspections, tests, and approvals for the installation and use of construction facilities, which are made or given by public authorities.

B. Permits: Submit copies of permits required by public authorities.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities".

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.

2. Electrical service: Comply with LIPA, NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certificates and permits.

1.5 PROJECT CONDITIONS

A. Obtain easements where required.

B. Coordinate scheduling of the implementation and termination of temporary facilities and services with all other Contractors affected and with all agencies having jurisdiction.

C. Use of permanent facilities prior to substantial completion is subject to the Construction Manager's approval and conditions.

1. Each permanent facility used for construction purposes shall be operated, maintained, and protected during such use by the original installer.

2. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities or permit them to interfere with progress of the Work. Do not allow hazardous or unsanitary conditions or public nuisances to develop or persist on the site.

3. Specified warranties shall not be reduced or voided by temporary use.

1.6 SEQUENCING AND SCHEDULING

A. Maintain required facilities until not needed or until shortly before substantial completion; remove facilities before substantial completion.

1. Exception: Where use of permanent facilities is allowed.

B. Change over to use of permanent facilities, when applicable, as soon as possible, except when use of permanent facilities is not allowed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials which are both suitable for the use and durable enough to withstand the use and abuse to be expected.

1. Trailers and containers utilized by the Contractors must be free of graffiti. Each Contractor shall be responsible to maintain its trailers and keep the containers free of graffiti at all times.

2. All trailers, containers, work boxes, large machinery, and equipment must be provided with legible signage identifying the respective Contractor's name.

3. Containers only will be permitted in the approved project staging and work areas. Contractors' office trailers will not be permitted either in the construction site, the adjacent streets, or in staging and work areas. Contractors' office trailers may be allowed at off-site locations designated by the Owner.

B. Tarpaulins: Waterproof and fire-retardant (UL Class A).

C. Temporary Heating Units: UL labeled for the fuel used; do not use gasoline-burning or open burning.

1. Use equipment that is known to be safe and that will not damage work in progress.

D. Water Hoses: Provide at every work area 3/4 inch heavy-duty abrasion-resistant flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

E. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

F. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion or traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

G. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

H. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heating and air-conditioning units on foundations adequate for normal loading.

I. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a fiberglass reinforced polyester shell or similar non-absorbent material.

J. First Aid Supplies: Comply with governing regulations.

K. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, Class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

1. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location of fire exposure.

2.2 TEMPORARY UTILITIES

A. Temporary Water Service:

1. Provide water adequate for demand of construction operations.

2. Provide piped water service:

a. Do not use permanent piping system to distribute non-potable water.

b. Connect to existing water main.

c. Connect to temporary plumbing fixtures.

d. Provide shut-off valve.

e. Disinfect temporary piping before use.

f. Provide minimum 5 gpm at all work locations.

g. Take precautions to prevent damage due to leaks and spills inside building.

3. Each Contractor shall provide and pay all costs for other water required for his operations.

B. Temporary Sanitary Sewer: Connect fixed temporary plumbing fixtures to sewer main.

C. Temporary Power:

1. Provide electricity adequate for demand of construction operations.

2. Electrical service:

a. Provide distribution equipment, feeders, and branch circuit panelboards to serve temporary lighting, temporary convenience receptacles, and other temporary facilities specified.

b. Temporary convenience receptacles: NEMA WD 6, Type 5-20R; locate within 25 feet of each point requiring power; use 20-ampere branch circuits.

3. Each Contractor shall provide and pay all costs for other power (for equipment 1/4 HP and above) required for his operations.

2.3 PROTECTIVE FACILITIES

A. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. All Contractors shall store combustible materials in containers in fire-safe locations.

3. All Contractors shall maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. All Contractors shall provide supervision of its welding operations, combustion type temporary heating units, and similar sources of fire ignition.

B. Site Fence: Install 8 feet high, chain link fence to prevent easy access to site by people and animals.

1. Enclose entire site.

2. Provide gates as required for access.

3. Do not remove until other security facilities, either temporary or permanent, are in place and in operation.

C. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red and amber lights.

D. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise.

1. From commencement to completion of the Work, keep all parts of the site and the project free from accumulation of water; supply, maintain, and operate all necessary pumping and bailing equipment.

2. Remove snow and ice as necessary for the protection and prosecution of the Work, and protect the Work against weather damage.

2.4 ADMINISTRATIVE FACILITIES

A. Telephone Service: Provide the following telephone service for use of all Contractors.

1. The General Contractor shall provide at least one telephone on the site or at a location approved by the Construction Manager.

2. Other telephone service is the responsibility of individual Subcontractors.

3. General Contractor shall display construction-related phone numbers at each pay phone.

a. Fire emergency number.

b. Rescue emergency number.

c. Physician.

d. General Contractors' home offices.

e. Construction Manager.

f. Architect.

B. Project Sign: The General Contractor shall provide the project identification sign, off-site, where directed.

1. Posts: Metal or treated wood.

2. Size: 4 by 8 feet.

3. Provide the following information on sign:

a. Project name.

b. Owner's name.

c. Architect's name.

d. Construction Manager's name.

e. Names of Prime Contractors.

f. Full color rendering of the project, up to 24 square feet in area, reproduced photographically from artwork provide by the Architect.

4. The Owner will furnish lettering and other graphic requirements.

2.5 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES

A. Locate storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.

1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Provide non-combustible construction for offices, shops and sheds located within the construction area, or within 30 feet of building lines. Comply with requirements of NFPA 241.

C. Field Offices: Each Prime Contractor shall provide insulated, weathertight temporary offices for its own use, of sufficient size to accommodate required office personnel assigned to the project. Locate field offices at an off-site location to be determined by the Owner. Keep offices clean and orderly.

1. In addition to temporary offices required for its own work, the General Contractor shall provide a temporary office for the Owner and the Construction Manager. This office shall contain minimum 400 square feet of space, and shall be provided with the following:

a. Heating and insulation sufficient to maintain minimum of 70 degrees F interior temperature in winter.

b. Air conditioning sufficient to maintain maximum of 75 degrees F interior temperature in summer.

c. Private toilet facilities with water closet, lavatory, and mirror-medicine cabinet unit.

d. Drinking water facilities.

e. Telephone service; one telephone for each desk.

f. The following furnishings:

1. 2 desks and desk chairs.

2. 2 drawing tables.

3. 2 plan racks.

4. 4 filing drawers.

5. 20 linear feet of bookshelving.

6. One desktop copier.

7. One facsimile (FAX) machine.

8. Conference table and chairs to accommodate 12 people.

D. Storage and Fabrication Sheds: Provide storage and fabrication sheds sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service.

E. Sanitary Facilities: Provide temporary toilets, wash facilities and drinking fountains. Comply with Board of Health, State and Local regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the project's needs. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility, including covered waste containers for used materials. At completion of the Work, clean all facilities and remove from the site.

1. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.

2. Wash facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

3. Drinking water facilities: Provide drinking fountains or containerized (bottled-water) type units for convenience for construction personnel, including paper cup supply.

F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. All temporary wood or plywood enclosures shall be UL-labeled fire-retardant treated material for framing and main sheathing.

G. Temporary Paving and Walkways: Construct and maintain temporary roads, paving and walkways to adequately support indicated loading and to withstand exposure to traffic during the construction period. Keep temporary access clean and provide dust control measures.

1. Extend temporary paving in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration, and supervision.

2. Note: This temporary paving is a construction road for construction vehicles, and is separate and apart from permanently paved areas.

H. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere on a daily basis. Comply with NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather

or 3 days when the temperature is expected to rise above 80 degrees F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

I. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished permanent stairs with a protective covering of plywood or similar material so that finishes will be undamaged at time of acceptance.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate temporary construction and facilities as directed by the Construction Manager.

B. Cooperate with other Contractors in location of temporary facilities.

3.2 TEMPORARY SERVICES

A. Waste Disposal Service: Provide contracted removal service at regular intervals.

1. Remove waste at least once a week.

2. When temperature exceeds or is expected to exceed 80 degrees F, remove at least twice a week.

3. Provide waste collection containers for use of all Contractors.

B. Janitorial Services: Clean toilet facilities at least once a week.

C. Extermination Service: Provide periodic extermination and pest control services.

1. Exterminate at least once before excavation work is complete.

2. Obtain and follow recommendations of experienced pest control company as to procedures required to minimize pests and their residue at completion of project.

D. Ice and Snow Removal: Remove ice and snow regularly.

3.3 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended use to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Construction Manager directs that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with a temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of the Contractor. The Owner reserves the right to take possession of the project identification sign.

2. Remove temporary paving and walkways that are not intended for integration into permanent paving. Repair or replace paving, curbs and sidewalks as required by governing authorities.

3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

   a. Replace air filters and clean inside of ductwork and housings. Comply with requirements of Section 01511, Construction IAQ Management.

   b. Replace significantly worn parts and parts that have been subjected to unusual operating conditions.

   c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 01500

SECTION 015110 - CONSTRUCTION IAQ MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and its subcontractors as described herein.

B. Section includes requirements for the development of a Construction Indoor Air Quality Management Plan (alternatively referred to as the Plan). The Plan shall be developed by the Contractor, or other qualified party as approved by the Owner and Architect. The Plan shall be implemented and documented throughout the duration of the project construction.

1. The Contractor shall provide, prior to the beginning of construction, a copy of the IAQ Plan and, upon completion of the project, the Construction IAQ Summary Report.

C. Related Sections:

1. Volatile Organic Compound (VOC) Limits For Adhesives, Sealants and Architectural Coatings: Elsewhere in Division 1.

2. All sections of the Specifications related to interior construction, MEP systems, and items affecting indoor air quality.

3. All sections including adhesives, sealants, and architectural coatings products.

4. Painting: Division 9.

1.2 CONSTRUCTION IAQ MANAGEMENT GOALS FOR THE PROJECT

A. The Owner has established that this Project shall minimize the detrimental impacts on Indoor Air Quality (IAQ) resulting from construction activities. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site, poor housekeeping, shall be minimized.

1.3 REFERENCES, RESOURCES

A. SMACNA IAQ Guidelines for Occupied Buildings Under Construction, First ed., Nov. 1995, The Sheet Metal and Air Conditioner National Contractors Association. (703) 803-2980, http://www.smacna.org.

B. ANSI/ASHRAE 52.2-1999, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", www.ashrae.org

1.4 CONSTRUCTION IAQ MANAGEMENT PLAN - OVERVIEW

A. The Contractor shall prepare and submit a Construction IAQ Management Plan to the Owner and Architect for approval. The Construction IAQ Management Plan shall meet the following criteria:

1. Construction activities shall be planned to meet or exceed the minimum requirements included in Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) "IAQ Guidelines for Occupied Buildings under Construction", First Edition, 1995;

2. Absorptive materials shall be protected from moisture damage when stored on-site and after installation;

3. Filtration media shall be installed to protect ductwork and/or equipment used during the construction process, per Item 2.1 FILTRATION MEDIA of this specification.

4. A Sequence of Finish Installation Plan shall be developed, highlighting measures to reduce the absorption of VOCs by materials that act as "sinks".

5. All habitable spaces within the building shall be subject to an Air Purge (Flush-out) immediately prior to occupancy.

1.5 IAQ SUBMITTALS REQUIREMENT

A. The Contractor and/or subcontractor shall submit the following required records and documents:

1. A construction schedule outlining the start-up date and expected duration of all Construction IAQ Management Plan control measures.

2. A copy of the Construction IAQ Management Plan and the Sequence Installation Plan, as defined herein.

3. A list of filtration media used, including manufacturer, model number, MERV value, location installed, and date of replacement prior to occupancy.

4. Product cut-sheets for all filtration media used during construction and installed immediately prior to occupancy, with MERV values highlighted. Cut sheets shall be submitted with the Contractor's or Subcontractor's 'approved' stamp as confirmation that the products submitted are the products installed on the project.

5. 18 photographs - 6 photographs taken on 3 different occasions during construction, labeled with the SMACNA approach illustrated - that document the implementation of the Construction IAQ Management Plan throughout the course of the project construction. Examples include photographs of ductwork sealing and protection, temporary ventilation measures, and conditions of on-site materials storage (to prevent moisture damage). Photographs shall include integral date stamping, and shall be submitted with brief descriptions, or be referenced to project meeting minutes or similar project documents.

PART 2 - PRODUCTS

2.1 FILTRATION MEDIA

A. If air handlers are used during construction, filtration media must be used at each return grill and have a Minimum Efficiency Reporting Value (MERV) of at least 8, as determined by ASHRAE 52.2-1999.

B. All filtration media shall be replaced immediately prior to occupancy and must have a Minimum Efficiency Reporting Value (MERV) of 13, as determined by ASHRAE 52.2-1999.

PART 3 - EXECUTION

3.1 CONSTRUCTION IAQ MANAGEMENT PLAN - DETAILED REQUIREMENTS

A. SMACNA Guidelines, as stated in Chapter 3 of the referenced "IAQ Guidelines for Occupied Buildings Under Construction", outline IAQ measures in five categories as listed below. The Construction IAQ Management Plan shall be organized in accordance with the SMACNA format, and shall address measures to be implemented by the Contractor and/or Subcontractors in each of the five categories (including subsections). All subsections shall be listed in the Plan; items that are not applicable for this project should be listed as such.

1. HVAC Protection: Shall include Return Side, Central Filtration, Supply Side and Duct Cleaning.

a. Contractor shall direct subcontractors to protect air handling and distribution equipment, and air supply and return ducting during construction. The designated person will inspect work and monitor subcontractor(s) to insure compliance.

b. All ductwork arriving on site shall be sealed with plastic sheeting and stored on pallets or dunnage until installed.

c. Contractor shall direct subcontractors to cover and protect all exposed air inlets and outlets, openings, grilles, ducts, plenums, etc. to prevent water, moisture, dust and other contaminate intrusion.

d. Duct runs shall be protected at the end day's work.

e. Contractor shall direct subcontractor to inspect temporary filtration weekly and replace as required to maintain the proper ventilation rates in the building.

2. Source Control:

a. Contractor shall direct subcontractors to protect stored on-site or installed absorptive or porous materials such as batt insulation.

b. Contractor shall not allow subcontractors to use wet damaged porous materials in the building.

c. Contractor shall require subcontractors to use low emitting paints, sealants, adhesives and carpet.

d. Product Substitution.

e. Modifying Equipment Operation.

f. Changing Work Practices.

g. Local Exhaust.

h. Air Cleaning.

i. Cover or Seal.

3. Pathway Interruption:

a. Depressurize Work Area.

b. Pressurize Occupied Space.

c. Erect Barriers to Contain Construction Areas.

d. Relocate Pollutant Sources.

e. Temporarily Seal the Building.

4. Housekeeping: Protect stored on-site or installed absorptive materials from moisture damage.

a. Store materials on elevated platforms under cover, and in a dry location.

b. If materials are not stored in an enclosed location, cover tops and sides of material with waterproof sheeting, securely tied.

c. Phase construction such that absorptive materials are installed only in areas that are weathertight.

5. Scheduling.

B. Protection of Materials from Moisture Damage: As part of the HOUSEKEEPING section of the Construction IAQ Management Plan, measures to prevent installed materials or material stored on-site from moisture damage shall be provided. This section should also describe measures to be taken if moisture damage does occur to absorptive materials during the course of construction.

C. Replacement of Filtration Media: Under the HVAC PROTECTION section of the Construction IAQ Management Plan, a description of the filtration media in all ventilation equipment shall be provided. The description shall include replacement criteria for filtration media during

construction, and confirmation of filtration media replacement for all equipment immediately prior to occupancy. Filtration media shall meet the requirements of Item 2.1 (Filtration Media) of this specification.

D. Sequence of Finish Installation for Materials: Absorptive materials should be installed after the installation of materials or finishes which have high short-term emissions of VOC's, formaldehyde, particulates, or other air-borne compounds. Absorptive materials include, but are not limited to: insulations (exposed to the air stream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, 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. The Contractor shall develop a sequencing schedule that identifies how the sequencing will occur for the project. The schedule shall be submitted to the Owner, Architect and CONSTRUCTION MANAGER in accordance with the Submittal Requirements of this Section.

E. If building HVAC systems are used to supply the ventilation air, filtration media shall be installed per the requirements of Item 2.1 (Filtration Media) of this specification.

F. Air Purging (Flush-out): Purging must be conducted after construction and immediately prior to initial occupancy, supplying 14,000 cu.ft. of 100% outdoor air per sq.ft. of floor area, while maintaining an internal temperature of at least 60 degrees F relative humidity no higher than 60%.

1. Conduct a minimum two-week building flush-out with MERV 13 filtration media and 100 percent outside air.

2. After flush-out, new MERV 13 filters must replace any filters that are ready for replacement.

G. Implementation and Coordination:

!. The Contractor shall be responsible for implementation of the Construction IAQ Management Plan, and for the coordination of the Plan with all affected trades. The Contractor shall designate one individual as the Construction IAQ Representative, who will be responsible for communicating the progress of the Plan with the Owner, Architect and CONSTRUCTION MANAGER on a regular basis. The Contractor shall include provisions in the Construction IAQ Management Plan for addressing conditions in the field that do not adhere to the Plan, including provisions to implement a stop work order, or to rectify non-compliant conditions.

2. Subcontractors shall be responsible for the implementation of specific control measures, as specified in the Construction IAQ Management Plan. Subcontractors shall coordinate their

responsibilities through the Contractor and their designated Construction IAQ Representative.

END OF SECTION 015110

SECTION 015910 – Construction Manager's (CM) FIELD OFFICE

PART 1 - GENERAL

1.1 SUMMARY

A. Installation Schedule: Within thirty (30) calendar days after receipt or Notice to Proceed, provide a complete functional CM field office facility in a location on the project site or as directed by the CM for the duration of the project.

B. Description: Provide a location within the Project boundary as agreed by the CM

C. Space Requirements:

1. Refer to CM field office requirement depicted in item 16 of the below table for details.

1.2 SUBMITTALS

A. No later than the date established by the CM for the Preconstruction Meeting provide full maintenance literature, data and details and suppliers' verification of availability and delivery schedule for the office unit and related items proposed to be furnished, all for approval by the CM. Do not begin delivery or installation of the CM's office facility items without such prior approval. Arrange the furnishings as required by the CM.

PART 2 – PRODUCTS

All products shall be new.

2.1 EQUIPMENT

A. Refer to CM field office requirement table below for details.

B. Telephone system: Provide centralized three (3) lines telephone system and wiring throughout facility, terminated at one central location for connection.

2.2 FURNISHINGS

A. Furniture: Refer to CM field office requirement table below for details.

B. CM field office requirement table: all furniture and equipment should be new (not previously used).

Items/Supplies for CM office Trailer

No.	Item	Description	Qty	Manufacturer	Comments
1	Laptops	DELL LATITUDE E5530	2	Dell	I7 10 CORE PROCESSOR 4.8 GHz 16 GB RAM 512 GB, M.2, PCIe NVMe, SSD 15 Inch Screen WINDOWS 10 PROFESSIONAL 64 BIT Integrated Intel Iris Xe Graphics INTERNAL SPEAKERS AND MIC EXTENDED WARRANTY FOR HARDWARE (recommended 5 years) Gigabit Network Port and WiFi
2	Mouse	Dell Mobile Wireless Mouse (Black) - MS3320W	2	Microsoft or similar	
3	Software	Microsoft Office 365. Adobe Standard 2020. CrowdStrike (with maintenance for the duration of contract)	2	Microsoft Adobe CrowdStrike	
4	NAS	Synology 211+ (Network Attached Storage)	1	Synology	For Central Storage and Backup
5	Western Digital Hard Drives	1TB Hard Drive (Black)	2	Western Digital	2 Hard Drives Provides Data Protection on site
6	ISP Contract	Obtain Broadband Isp Contract For Duration Of Project With A Minimum Of 1.5 Mbps And To Include Wireless Router	1	ISP	Installed and maintained for duration of project
7	Network Switch	NETGEAR ProSafe GS105	1	Netgear	
8	UPS Battery Backup	APC BK350 UPS	1	APC	
9	UPS Battery Backup	APC BE350***G*** UPS	1	APC	
10	Printer	Ricoh Aficio C2051 or similar. Color printer, scanner, fax and scan.	1	Ricoh	Includes installation and setup
11	Telephone	2-line desk telephones. 1 to be wireless. Telephone company Service to include voicemail.	3		Includes installation and setup
12	Refrigerator	Daewoo - 4.4 cu. Ft compact refrigerator or similar	1	Daewoo	

Items/Supplies for CM office Trailer

No.	Item	Description	Qty	Manufacturer	Comments
13	Connection, cables, and all ink for printer	Provide fully functional office for duration of project. All data cables shall be CAT 6.			Duration of project
14	USB HUB	Dynex - 4-port USB 2.0 Hub	2	Dynex	
15	Security System	24/7 office trailer security system w/ key pad at min door	1		Duration of project
16	Field Trailer Office	MO6412 - 60' x 12' office w/ skirt with water mainline connection.	1	Williams Scotsman or similar	Water mainline connection, sewer services, electrical connection. (include all required inspections and tie downs)
17	Voice & Fax	3-line (2-voice, 1-fax)	3		Installed and ready for use
18	Office Chairs	True Innovations - Puresoft polyurethane office chair or similar	4	True Innovations or similar	Assembled
19	File Cabinets	Staples® Vertical File Cabinet, 26-1/2", 4-Drawer, Legal Size, Black	4	Staples	Assembled
20	Drawing Rack w/ sticks	Safco® Sheet File Mobile Plan Center, 18 Hanging Clamps, 43-3/4w x 20-1/2d x 51h, Sand	1	Safco	Assembled
21	Folding Table	Staples® 8' Folding Melamine Banquet Table. (29 1/2"H x 30"W x 96"L)	2	Staples	Assembled
22	Folding Chairs	Staples® Steel Folding Chair, Black with Luxura™ Seat, 4/Pack	10	Staples	Assembled
23	Office desk	Bush® Somerset 60" Double-Pedestal Desk, Hansen Cherry Finish or similar	2	Bush	Assembled
24	Office Fire Extinguisher	ABC 20 Extinguisher	1		As required by code
25	Garbage Can	Staples® Wastebasket, Black, 7 Gallons	2	Staples	
26	Garbage Can	Rubbermaid® Slim Jim Wastebasket, Gray, 23 Gallons	2	Rubbermaid	

Items/Supplies for CM office Trailer

No.	Item	Description	Qty	Manufacturer	Comments
27	Office Shelves	Iceberg Rough N Ready 4 Shelf Open Storage System, Resin, 32w x 13d x 54h, Black	4	Iceberg or similar	Assembled

2.3 SIGN

A. Provide a 2'-0" by 5'-0" exterior project sign with half round frame, painted and lettered in accordance with NCDPW graphic requirement and as directed by the CM.

PART 3 - EXECUTION

3.1 SERVICES AND CONNECTIONS

A. Connect water, sanitary, and other required services to the existing public utilities systems, adequately sized and correctly placed to perform their function without damage or interruption of service.

3.2 MAINTENANCE SERVICE

A. Provide all maintenance including power, light, heat, water, sanitary, and janitorial service during the contract period or until final completion and removal is directed by the CM. Pay all service fees. Keep in neat and clean condition and wash windows periodically.

3.3 REMOVAL AND CLEAN UP

A. Remove the complete CM's Office Facility promptly upon written direction from the CM. Disconnect cap or remove all services as appropriate and leave the area free of any undesirable features resulting from the installation and restore it back to its original condition. All equipment and furnishings supplied by Contractor under this Section will remain property of NCDPW at the completion of the project.

END OF SECTION

SECTION 016000 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and its Subcontractors as described herein.

B. Unless otherwise specifically indicated in the contract documents, reference to equipment, material, article, or patented process, by trade name, model or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. Contractor may submit other equipment, material, article, or process for approval, provided all requirements of the contract documents are met, and equality is proven (in the sole judgement of the Architect) by the Contractor.

C. Definitions:

1. "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for the project or taken from Contractor's stock of previously purchased products.

2. "Materials" is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.

3. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.).

4. Definitions an this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and recognized meanings in the construction industry.

1.2 QUALITY ASSURANCE

A. Source Limitation: To the greatest extent possible for each unit of work, and subject to the restrictions of the Buy America Act, provide products, materials and equipment of a single generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product or material, select an option which is compatible with other products and materials already selected (which may have been from among options for those other products and materials). Total compatibility among options is not assured by limitations with contract documents, but must be provided by Contractor. Compatibility is a basic general requirement of product/material selections.

C. Labels and Listings: Where equipment or materials are specified to conform to requirements of standards of organizations such as American Society of Mechanical Engineers (ASME), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration

Institute (ARI), Air Diffusion Council (ADC), Sheet Metal and Air-Conditioning Contractors National Association, Inc. (SMACNA), and Air Moving and Conditioning Association (AMCA), that use a label or listing as a method of indicating compliance, proof of such conformance shall be submitted to the Architect. The label or listing of the specified organization will be acceptable evidence. In lieu of a label or listing, Contractor may submit a notarized certificate from a nationally recognized testing organization, adequately equipped and competent to perform such services and approved by the Architect, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard or code. For materials whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a notarized certificate from the manufacturer shall be furnished to the Architect stating that the material complies with the applicable referenced standard or specification.

1.3 TRANSPORTATION AND HANDLING

A. Materials, products, and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

B. More detailed requirements for transportation and handling are specified under the technical Sections.

1.4 STORAGE AND PROTECTION

A. Provide suitable temporary weathertight storage facilities as may be required for materials that will be damaged by storage in the open.

B. Available storage space at the job site is limited to the area permitted by the Owner/CONSTRUCTION MANAGER. Allocate such space for storage purposes. Any additional off-site space required is the responsibility of the Contractor.

C. Allocate the available storage areas and coordinate their use by the trades on the job. Maintain a current layout of all storage facilities.

D. Store and protect materials delivered at the site from damage. Do not use damaged material on the work.

E. In the event that it is necessary for the Contractor to store any materials offsite, Contractor shall first obtain the approval of the Owner/CONSTRUCTION MANAGER in advance. The Contractor shall be responsible for insurance and warehousing charges of any materials stored offsite. The Contractor shall also be responsible for the cost of delivery to the job site of any materials that have been stored offsite.

1.5 PRODUCT APPROVAL STANDARDS

A. Where the words "or approved equal" or other synonymous terms are used, it is expressly understood that they shall mean that the approval of any such submission is vested in the Architect/Engineer, whose decision shall be final and binding upon all concerned. All submissions are subject to such approval and shall conform to the requirements of Section 01300.

1.6 TEMPORARY USE OF EQUIPMENT

A. No equipment intended for permanent installation shall be operated for temporary purposes without the written permission of the Owner/Architect/Engineer/Construction Manager.

B. The temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment or any work or materials supplied under this Contract before final completion and written acceptance by the Architect, shall not be construed as evidence of the acceptance of same by the Owner. The Owner shall have the privilege of such temporary and trial usage, for such reasonable length of time as and when the Architect/Engineer shall deem to be proper for making a complete and thorough test of same and no claim for damage shall be made by the Contractor for the injury to or breaking of parts of such work which may be caused by weakness or inaccuracy of structural parts or by defective material or workmanship. If the Contractor so elects, he may at his own expense, place a competent person or persons to make such trial usage; such trial usage shall be under the supervision of the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCES

A. General: The compliance requirements, for individual products as indicated in the contract documents, are multiple in nature and may include generic, descriptive, performance, prescriptive, compliance with standards, conformance with graphic details, and other similar forms and methods of indicating requirements, all of which must be complied with.

B. Procedures for Selecting Products: Contractor's options for selecting products are limited by contract document requirements and governing regulations, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, the following for various indicated methods of specifying:

1. Standards, Codes and Regulations: Where only compliance with an imposed standard, code or regulation is required, selection from among products which comply with requirements, including those standards, codes and regulations, is Contractor's option.

2. Performance Requirements: Provide products which comply with specific performances indicated, and which are recommended by manufacturer (in published product literature or by individual certification) for application indicated. Overall performance of a product is specified with only certain specific performance requirements.

3. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing, and similar operations in manufacturing process.

4. Visual Matching: When matching to an existing product/surface or to an established sample is required, final judgment of whether a product proposed by Contractor matches sample satisfactorily rests with the Architect.

5. Visual Selection: Except as otherwise indicated, where specified product requirements include "...as selected from manufacturer's standard colors, patterns, textures..." or words

of similar effect, the selection of manufacturer and basic product (complying with requirements) is Contractor's option, and subsequent selection of color, pattern and texture rests with the Architect.

C. General Requirements for Electrical Work: The following applies to electrical work, unless otherwise specified:

1. Comply with NEC.

2. Arrange conduits, wiring and equipment generally as indicated. Any change resulting in a savings in labor or materials shall be made only in accordance with a Change Order. Deviations shall be made only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Architect.

2.2 GENERAL PRODUCT REQUIREMENTS

A. General: Provide products which comply with the clause "MATERIALS AND WORKMANSHIP" of the General Conditions, and which are undamaged and unused at time of installation, and which are complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use and effect.

1. Standard Products: Products shall be essentially the standard catalogued products of manufacturers regularly engaged in production of such products and shall be the manufacturer's latest standard design that complies with the specification requirements. Equipment shall essentially duplicate items that have been in satisfactory commercial and industrial use at least two years, or more if otherwise specified, prior to bid opening; or in lieu thereof, shall have been used and operated in a test installation which, in the opinion of the Architect, duplicate its field performance for the same period of time. The Architect reserves the right to require the Contractor to submit evidence to this effect for his approval. When two units of the same class of equipment are required, these units shall be the product of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer.

B. Continued Availability: Products which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

2.3 LABELS AND NAMEPLATES

A. General: To the extent feasible and consistent with the following requirements pertaining to the appearance of the finished construction, wherever a product is required to comply with a specified standard, grade, class or type, a permanent label to this effect shall be applied to the product. Where this is not feasible because of the nature of the product, the label shall be on or inside of each container.

B. Nameplates: Except as otherwise indicated for required approval labels and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.

C. Labels: Locate required labels and stamps on a concealed surface or, where required for

observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

D. Equipment Nameplates: Provide permanent nameplate on each item of service-connected or power operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings, and similar essential operating data. Locate nameplates on an easily accessed surface which, in occupied spaces, is not conspicuous.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 016000

SECTION 016310 - PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and its Subcontractors as described herein.

B. Section Includes:

1. General product requirements, including:

a. Product options.

b. Procedures for substitution requests.

C. Related Sections:

1. Submittal transmission, handling, and action procedures: Elsewhere in Division 1.

1.2 DESCRIPTION OF REQUIREMENTS

A. Definitions: Definitions used herein are not intended to negate the meaning of other terms used in the contract documents, including such terms as "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material", "equipment", "system", and other terms of similar intent.

a. "Named Products" are products identified by use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the contract documents.

2. "Materials" are products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.

3. "Equipment" is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

B. Inclusion of Non-Specified Products Prior to Bid Date: For inclusion of products other than those specified, bidders shall submit a request in writing at least 15 days prior to bid date. Requests received after this time will not be reviewed or considered regardless of cause. Requests shall clearly define and describe the product and all implications to the Contract work, including design, for which inclusion is requested. Inclusion, if accepted by the Architect/Engineer, will be

in the form of an addendum to the contract documents issued to all bidders on record.

C. Substitutions After Award of Contract: The Contractor's requests for changes in the products, materials, equipment, and methods of construction required by the contract documents are considered requests for "substitutions", and are subject to the requirements specified herein. The following are not considered as substitutions:

1. Revisions to the contract documents, where requested by the Owner or Architect/Engineer are considered as "changes", not substitutions.

2. Substitutions requested during the bidding period, which have been accepted prior to the bid date, are included in the contract documents and are not subject to the requirements for substitutions as herein specified.

3. Specified Contractor options on products and construction methods in the contract documents are choices available to the Contractor and are not subject to the requirements for substitutions as herein specified.

4. Except as otherwise provided in the contract documents, the Contractor's determination of and compliance with governing regulations and orders as issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.

D. Sub-Contracts: Provisions of this section apply to the work of each sub-contractor. It is the responsibility of each separate prime contractor to provide work that is compatible with the work of each other prime contractor or separate contractor. In the event a dispute arises between separate prime contractors regarding priority where concurrently selectable products are incompatible, the Architect/Engineer shall determine which products are sustained and which are incompatible and must be replaced.

1. Where a proposed substitution involves the work of more than one sub-contractor, each sub-contractor involved shall cooperate and coordinate the work with each other sub-contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.

2. Where a proposed substitution involves a change in the work of another sub-contractor, the sub-contractor requesting the substitution shall assume responsibility for any added costs of the other sub-contractor resulting from the substitution.

3. Where a proposed substitution involves or necessitates a change in the documents of any sub-contractor by the Architect/Engineer, the sub-contractor requesting the substitution shall assume responsibility for any costs of the Architect/Engineer, including but not limited to redesign costs, reproduction costs, and additional costs of administration. Such costs of the Architect shall be at a rate commensurate with the rates established in the Owner/Architect Agreement for additional services.

1.3 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.

1. When it is discovered that specified products are available only from sources that do not or

cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect for a determination of what product qualities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect's/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the contract documents, but must be provided by the Contractor.

1.4 SUBMITTALS

A. Requests for Substitutions after Award of Contract: Submit one original and three copies of each request for substitution. For each request for substitution, identify the product or fabrication or installation method to be replaced by the substitution; include related specification section and drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include the following information, as appropriate, with each request:

1. Provide complete product data, drawings and description of products, and fabrication and installation procedures.

2. Provide samples where applicable or requested.

3. Provide a detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities include elements such as size, weight, durability, performance, and visual effect where applicable.

4. Provide complete coordination information. Include all changes required in other elements of the work to accommodate the substitution, including work performed by the Owner and separate contractors.

5. Provide a statement indicating the effect the substitution will have on the work schedule in comparison to the schedule without approval of the proposed substitution. Include information regarding the effect of the proposed substitution on the Contract Time.

6. Provide complete cost information, including a proposal of the net change, if any, in the Contract Sum.

7. Provide certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the contract documents, and that it will perform adequately in the application indicated.

    a. Include in this certification, the Contractor's waiver of rights to additional payment or time, which may subsequently be necessary because of the failure of the substitution to perform adequately, and the Contractor's obligation to assume responsibility for any

additional cost: to the Owner by reason of additional services of the Architect/Engineer); to other Prime Contractors; to subcontractors and subcontractors of other separate contractors which may arise by virtue of the request for substitution.

b. Provide a Producer's Statement of Applicability.

B. Action by the Architect/Engineer: Within two weeks of receipt of the Contractor's request for substitution, the Architect/Engineer will request additional information or documentation as may be needed for evaluation of the request. Within two weeks of receipt of the request, or within one week of receipt of the requested additional information or documentation, whichever is later, the Architect/Engineer will make a recommendation to the Owner of either the acceptance or rejection of the proposed substitution.

1. Acceptance will be in the form of a change order.

2. Rejection will include a statement giving reasons for the rejection.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle product in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control delivery schedules to minimize long-term storage at the site and to prevent overcrowding of construction spaces. In particular, coordinate delivery and installation to ensure minimum holding or storage of items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss.

B. Deliver products to the site in manufacturer's sealed containers or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

C. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

D. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

A. General: Requirements for individual products are indicated in the contract documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one of several different specifying methods, or in any combination of these methods. These methods include the following:

1. Proprietary.

2. Descriptive.

3. Performance.

4. Compliance with Reference Standards.

5. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the contract documents also having a bearing on the selection process.

B. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to, the following for the various indicated methods of specifying:

1. Proprietary and semi-proprietary specification requirements:

a. Single product name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.

b. Two or more product names: Where two or more products or manufacturers are named, provide one of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are feasible for use.

c. Where products or manufacturers are specified by name, accompanied by the term "or equal" or similar language, comply with contract document provisions concerning "substitutions" to obtain approval for the use of an unnamed product.

2. Non-proprietary specification requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with contract requirements.

3. Descriptive specification requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand or trade name, provide products or assemblies that provide the characteristics indicated and otherwise comply with contract requirements.

4. Performance specification requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performance.

5. Compliance with standards, codes, and regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including

6. Visual matching: Where matching an established sample is required, the final judgment of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with provisions of the contract documents concerning "substitutions" and "change orders" for the selection of a matching product category, or for non-compliance with specified requirements.

7. Visual selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.

8. Producer's statement of applicability: Where the individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect's/Engineer's specification and the Contractor's selection of the product for use in the Work. The statement shall also state that the proposed application of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

A. Conditions: The Contractor's request for a substitution will be received and considered when extensive revisions to the contract documents are not required, when the proposed changes are in keeping with the general intent of the contract documents, when the requests are timely, fully documented and properly submitted, and when one or more of the following conditions is satisfied; otherwise, the requests will be returned without action except to record noncompliance with these requirements.

1. The Architect/Engineer will consider a request for substitution where the request is directly related to an "or equal" clause or similar language in the contract documents.

2. The Architect/Engineer will consider a request for substitution where the specified product or method cannot be provided within the Contract Time. However, the request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or to coordinate the various activities properly.

3. The Architect/Engineer will consider a request for substitution where the specified product or method cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

4. The Architect/Engineer will consider a request for substitution where a substantial advantage is offered the Owner, in terms of cost, time, energy conservation, or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the

increased cost of other work by the Owner or other separate contractors, and similar considerations.

a. Where such advantage to the Owner is offered, the Contractor shall provide a statement as to the amount of cost, time or other consideration.

b. The Architect/Engineer will consider a request for substitution when the specified product or method cannot be provided in a manner which is compatible with other materials in the work, and where the Contractor certifies that the proposed substitution will overcome the incompatibility.

c. The Architect/Engineer will consider a request for substitution when the specified product or method cannot be properly coordinated with other materials in the work, and where the Contractor certifies that the proposed substitution can be properly coordinated.

d. The Architect/Engineer will consider a request for substitution when the specified product or method cannot receive a warranty as required by the contract documents and where the Contractor certifies that the proposed substitution will receive the required warranty.

B. Work-Related Submittals: The Contractor's submittal, and the Architect's/Engineer's review, of shop drawings, product data or samples which relate to work not complying with requirements of the contract documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

2.3 GENERAL PRODUCT REQUIREMENTS

A. General: Provide products that comply with the requirements of the contract documents and that are undamaged and, unless otherwise indicated, unused at time of installation. Provide products that are complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.

1. Standard products: Where they are available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

2. Continued availability: Where, because of the nature of its application, the Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced products for which the manufacturer has published assurances that the product and its parts are likely to be available to the Owner at a later date.

B. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on an easily accessible surface which is inconspicuous in occupied spaces. Nameplate shall contain the following information and other essential operating data:

1. Name of manufacturer.

2. Name of product.

3. Model number.

4. Serial number.

5. Capacity.

6. Speed.

7. Ratings.

C. Identifying Markings: Nameplates and other identifying markings shall not be affixed on exposed surfaces or manufactured items installed in finished spaces.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Except as otherwise indicated in individual specification sections, comply with manufacturer's instructions and recommendations for installation of the products and the applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

END OF SECTION 016310

SECTION 017000 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

A. Work specified in this section is applicable to the General Contractor and its Subcontractors as described herein.

B. Section includes administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.

2. Project record document submittal.

3. Operating and maintenance manual submittal.

4. Submittal of warranties.

5. Final cleaning.

C. Definition: Closeout is hereby defined to include general requirements near the end of Contract Time, in preparation for final acceptance, final payment, normal termination of the Contract, occupancy, and similar actions evidencing completion of the Work.

1. Specific requirements for individual units of work are specified in Sections of Divisions 2 through 28.

2. Time of closeout is directly related to Substantial Completion and, therefore, may be either a single time period for the entire Work or a series of time periods for individual parts of the Work which have been noted as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List the exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these contract documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Submit specific warranties, workmanship bonds (if any), maintenance agreements, final certifications, and similar documents.

3. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates, and similar releases.

4. Deliver tools, spare parts, extra stock, and similar items.

5. Complete start-up testing of systems, and instruction of Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

B. Inspection Procedures: On receipt of a request for inspection, the Architect/Engineer will either proceed with inspection or advise each Prime Contractor of unfilled requirements. The Architect/Engineer will prepare the Certificate of Substantial Completion following inspection, or advise each Prime Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Architect/Engineer will repeat inspection when requested and assured the Work has been substantially completed.

2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.3 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List the exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Architect's/Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect.

4. Submit consent of surety to final payment.

5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Reinspection Procedure: The Architect/Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.

1. Upon completion of reinspection, the Architect/Engineer will prepare a certificate of final acceptance, or advise each Prime Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

2. If necessary, reinspection will be repeated.

1.4 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.

B. Record Drawings: Architect will provide each Prime Contractor with CADD files of the Contract Drawings. Each Prime Contractor shall update the CADD files to "As-Built" conditions and provide two (2) sets of prints for review by the Architect. Architect will return one (1) set of prints to the Contractor. Upon approval by the Architect, Contractor shall provide one set of mylars and an electronic file of the "As-Built" drawings to the Owner and Construction Manager.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data.

1. Upon completion of the Work, submit record specifications to the Architect and Construction Manager for the Owner's records.

D. Record Product Data, Certifications, and Laboratory Test Reports: Maintain one copy of each product data submittal, product certification, and laboratory test report. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark-up of record drawings and specifications.

1. Upon completion of mark-up, submit complete set of record product data, certifications, and laboratory test reports to the Architect and Construction Manager for the Owner's records.

E. Survey of Outside Utility Lines: Upon completion of the Work, submit an acceptable and accurately dimensioned survey showing location and elevation of all utility lines (water, gas, electric, sewer, etc.), including valves, connections and changes in direction, as installed under the Contract, within the project lines and outside the building walls. Points where utility lines emerge from the building shall be located from building corners. Points where utility lines leave the property shall be located from lot monuments.

1. Draw to scale with waterproof ink or tracing cloth, or on a reproducible film which is equivalent to waterproof ink or tracing cloth, as approved by the Architect.

2. Submit survey of utility lines to the Architect for the Owner's and Construction Manager’s records.

F. Record Sample Submittals: Immediately prior to the date or dates of Substantial Completion,

the Contractor will meet at the site with the Architect, Construction Manager and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.

G. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect for the Owner's and Construction Manager's records.

H. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Emergency instructions.
2. Spare parts list.
3. Copies of warranties.
4. Wiring diagrams.
5. Recommended "turn around" cycles.
6. Inspection procedures.
7. Shop drawings and product data.
8. Fixture lamping schedule.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed revue of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.

4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities and Services".

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions where applicable.

1. Complete the following cleaning operations before requesting inspection for Certificate of Substantial Completion.

a. Remove labels that are not permanent labels.

b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition.

d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved or planted, to a smooth, even-textured surface.

C. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 017000

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 024116 "Structure Demolition" for disposal of waste resulting from the demolition and removal of buildings, below grade construction and new site utilities.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

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

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to

Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 14 days of date established for the Notice of Award.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator and refrigerant recovery technician.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

I. Refrigerant Recovery: Comply with requirements in Section 024116 "Structure Demolition" for

refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may not serve as Waste Management Coordinator.

B. Refrigerant Recovery Technician Qualifications: Universal certified by EPA-approved certification program.

C. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024116 "Structure Demolition."

D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements of the County. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 024116 "Structure Demolition."

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in transportation and tipping fees by donating materials.
7. Savings in transportation and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS

2.1 RECYCLING RECEIVERS AND PROCESSORS

A. Subject to compliance with requirements. Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

2.2 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials including the following:

1. Demolition Waste:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.

e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.
pp. <**Insert materials required**>.

2. Construction Waste:

a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging

materials:

m. Paper.
   1) Cardboard.
   2) Boxes.
   3) Plastic sheet and film.
   4) Polystyrene packaging.
   5) Wood crates.
   6) Wood pallets.
   7) Plastic pails.

n. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:

   1) Paper.
   2) Aluminum cans.
   3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

   1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

   1. Distribute waste management plan to the Construction Manager, Resident Engineer, and other concerned project stakeholders within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
   2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials

shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024116 "Structure Demolition for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale and Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site.
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.

I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum

contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 4-inch size.

1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.
2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch size.

    a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.
    b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

N. Conduit: Reduce conduit to straight lengths and store by material and size.

O. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
   a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

3.7 ATTACHMENTS

A. Form CWM-1 for construction waste identification.

B. Form CWM-2 for demolition waste identification.

C. Form CWM-3 for construction waste reduction work plan.

D. Form CWM-4 for demolition waste reduction work plan.

E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.

F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.

G. Form CWM-7 for construction waste reduction progress report.

H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION 017419

SECTION 02070

REMOVAL OR PERMANENT CLOSURE OF UNDERGROUND STORAGE TANKS

PART 1 - GENERAL

1.01 SCOPE OF WORK:

The Contractor shall furnish all labor, equipment, and materials required to perform all operations necessary to remove soils, dispose of tank contents, residues, contaminated soils and debris and remove and dispose of or permanently close underground storage tanks by filling with concrete, as required by the Contract Documents or as required by the Construction Manager. Multiple Underground Storage Tanks (UST) are present on site, which includes a 6,000 diesel tank, a 10,000 diesel tank and a 1,000 UST.

1.02 APPLICABLE REFERENCES:

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only and shall be the latest published versions.

1.02.1 American Petroleum Institute (API)

API Publ 1628	Assessment and Remediation of Underground petroleum Releases
API RP 2015	Cleaning Petroleum Storage Tanks
API RP 1604	Removal and Disposal of Used Underground Petroleum Storage Tanks

1.02.2 Environmental Protection Agency (EPA)

EPA 8021	1987 VOCs in Water by Purge and Trap Capillary Column Gas Chromatography with PID and Electroconductivity Detector in Series
EPA 8270	1986 SVOCs in Water by Gas Chromatography/Mass Spectrometry Using a Capillary Column

1.02.3 New York State Department of Environmental Conservation (NYSDEC)

6 NYCRR Part 612	Registration of Bulk Storage Facilities
6 NYCRR Part 613	Handling and Storage of Petroleum
6 NYCRR Part 614	Standards for New and Substantially Modified Petroleum Storage Facilities
NYSDEC Memo #1	NYSDEC STARS Memo #1: Petroleum-Contaminated Soil Guidance Policy
NYSDEC Guidance Document	NYSDEC SPOTS No. 14: Site Assessments at Bulk Storage Facilities

1.03 RELATED WORK:

SECTION 028200:	ASBESTOS ABATEMENT
SECTION 02210:	GENERAL EXCAVATION
SECTION 02575:	MEP

1.04 PERMIT AND LICENSE REQUIREMENTS:

Prior to the start of work under this Contract, any permits or licenses required to perform the work shall be obtained by the Contractor at the Contractor's own cost and expense. Determining license and permit requirements shall be the responsibility of the Contractor.

1.04.1 New York State Department of Environmental Conservation (NYSDEC)

A. Storage tanks must be registered with NYSDEC. If a tank is going to be closed or its use will change, and it is not currently registered, the tank must be registered by the Contractor before proceeding. The Contractor shall notify NYSDEC (Region 2) of the intent to close the tank 30 days prior to initiation of closure activities.

B. The Contractor shall, in addition to other requirements of these specifications, comply with the requirements of 6 NYCRR Parts 612, 613 and 614, NYSDEC Memo #1, and NYSDEC Guidance Document.

1.04.2 Safety Precautions

A. Removal work shall not start until the readings from the explosion meter indicate that a safe and non-explosive tank atmosphere has been achieved as evidenced by readings less than ten percent (10%) of the lower explosive or flammable level at all elevations within the tank. Removal work shall be progressed diligently and expeditiously without interruption until its completion. The explosion meter shall be used to take subsequent readings periodically or continuously as directed by the Construction Manager as work is progressing. If any reading indicates a dangerous level is approaching, work shall cease, the workers shall exit the tank, and additional carbon dioxide shall be introduced into the tank until safe conditions are restored to all levels within the tank.

B. The Contractor shall permit only trained and properly equipped personnel to enter the tank in accordance with all OSHA requirements for permitted entry space. Tanks shall not be entered unless personnel have and use proper self-contained breathing apparatus and standby personnel similarly equipped are present at the site to safeguard and protect those working in the tank. Workers in the tank shall also have and use appropriate harnesses and lifelines connected to personnel retrieval equipment fully rigged, and ready for use.

1.05 PROTECTION OF EXISTING STRUCTURES AND UTILITIES:

All necessary precautions shall be taken to assure that no damage occurs to existing structures and appurtenances and utilities to remain in place. Any buried utilities encountered which are not shown on the Contract Drawings marked out by the Contractor, or otherwise indicated, shall be reported immediately to the Construction Manager and shall not be disturbed without prior approval of the Construction Manager.

1.06 SPILL PREVENTION:

Any releases to the environment of tank contents or cleaning liquids shall be remediated by the Contractor as approved by the Construction Manager at no cost to the Owner. Spill prevention measures shall be fully described in the Spill Prevention and Control Plan as specified in Section 01495: SPILL PREVENTION AND CONTROL.

1.07 DIGGING PERMITS AND ROAD AND/OR PARKING LOT CLOSINGS:

The Contractor shall obtain all necessary base excavation (digging and road/parking for closing) permits from the Nassau County Public Works Department before starting any excavation work on this project. The Contractor shall allow fourteen (14) calendar days from date of written application to receive permission to dig and to partially close roads and/or parking lots.

1.08 REMOVED MATERIAL:

Except as otherwise set forth in these Specifications or as limited by the Construction Manager, all removed materials shall become the property of the Contractor who shall promptly remove them from the work site and dispose of the same in accordance with Part 3 of this Section. Storage of removed material within the work site will not be permitted.

1.09 SUBMITTALS:

A. Plan of Operations. A Plan of Operations shall be prepared and submitted to the Construction Manager for approval within fifteen (15) days after the date of Notice to Proceed. The plan shall describe methods, equipment, and sequences of operations, including, but not limited to:

1. Tank contents removal;
2. Spill prevention;
3. Exploratory excavations;
4. Tank purging procedure;
5. Interior and exterior tank cleaning procedure;
6. Wastewater collection and disposal;
7. Facility to perform analyses;
8. Permanent closure of underground storage tank; and
9. Anticipated use, recycling or disposal of contents; and
10. Soil/Groundwater Sampling procedure
11. Backfilling compaction and grading
12. Disposal of petroleum storage tanks
13. Safety and health plan

Work shall not be started until the plan has been approved by the Construction Manager. The plan shall recognize and account for all Nassau County requirements associated with the subject activities, as it relates to access, scheduling, equipment usage/storage and noise attenuation.

B. Chemical Data Acquisition Plan: A Chemical Data Acquisition Plan (CDAP) for sampling of soil and groundwater to be disposed of off-site shall be provided to the Construction Manager and the NYSDEC prior to the start of work.

C. Results of Testing: Documentation of the soil and groundwater disposal sampling performed, including analytical results, shall be provided to the Construction Manager and to the NYSDEC.

D. Waste Manifests. Copies of manifests required to transport any waste materials shall be furnished to the Construction Manager not later than the day following their preparation.

E. Documentation of Treatment or Disposal. Documentation of acceptance of waste materials by a facility legally permitted to treat or dispose of those materials shall be furnished to the Construction Manager not later than seven (7) days following delivery of those materials to the facility.

F. Letters of acceptance from the facility and haulers acknowledging agreement to accept the waste material shall be furnished to the Construction Manager not more than fourteen (14) days before transporting any hazardous or toxic materials.

1.10 TANK DESCRIPTIONS:

A. Locations: General locations of all tanks are shown on the Contract Drawings. Specific locations of tanks shall be defined by exploratory excavations performed by the Contractor. The cost of exploratory investigations shall be borne by the Contractor.

B. Tank Contents: Tanks have been used for storage of petroleum products.

PART 2 - PRODUCT

(Not Used)

PART 3 - EXECUTION

3.01 TANK CONTENTS REMOVAL AND DISPOSAL:

3.01.1 Salvageable petroleum products. Salvageable oil and/or fuel becomes the property of the Contractor for beneficial use or disposal at no additional expense to the Owner.

3.01.2 Sludge Material (Temporary Storage). Sludge shall be collected in new or reconditioned 55-gallon drums or roll-off containers. Drums or containers shall be sealed water-tight to prevent rain infiltration and leaking of sludge and stored on-site in such a manner that the contents will not spill or leak. Chemical sampling and analyses of sludge shall be conducted and paid for by the Contractor in accordance with environmental regulatory requirements, as approved by the Construction Manager. Analytical results shall be provided to the Construction Manager as soon as possible after receipt of results. Drums or containers shall be labeled in accordance with Federal and State Regulations.

3.01.3 Contaminated Water. Contaminated water shall be collected in new or reconditioned 55-gallon drums or roll-off containers. Drums or containers shall be sealed water-tight to prevent infiltration and leaking of water. Drums or containers shall be stored on-site in such a manner that the contents will not spill or leak. Chemical sampling and analysis of the waste shall be conducted and paid for by the Contractor in accordance with environmental regulatory requirements, as approved by the Construction Manager. Analytical results shall be provided to the Construction Manager within five (5) working days after receipt of results. Drums or containers shall be labeled in accordance with federal and State Regulations. All tanks shall be pumped completely dry before being removed. All water shall be transported and disposed of in accordance with applicable laws. All product shall be disposed of according to applicable laws. During the emptying operation the following restrictions shall apply:

A. Smoking shall be banned in the area

B. All open flame and spark producing equipment within the area shall be shut down

C. All electrical and internal combustion equipment not marked "Explosion Proof" shall be removed

D. Only "non-sparking" tools shall be used

E. Static electricity shall be controlled

F. The work area shall be secured

3.01.4 Disposal. Sludge shall not be on-site for more than 90 days. Information and documentation requirements including any required sampling for transport, salvage, treatment or disposal shall be determined and provided by the Contractor. Sludge shall be disposed of in accordance with environmental regulatory requirements at no additional cost to the Owner.

3.02 CLEANING OF TANK:

A. The Contractor shall provide an explosion meter to monitor the tank atmosphere before, during and after the cleaning and purging procedures.

B. All tanks shall be cleaned prior to disposal of all residue and product clinging to their surfaces. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors. Storage tanks shall be cleaned in accordance with API RP 2015. Steam shall not be used for either purging or cleaning a tank or other equipment. An affidavit of such purging, signed by the Contractor's licensed UST system installer, shall be filed by the Contractor with the Nassau County Division of Fire Prevention.

C. The Contractor shall comply with all OSHA requirements and regulations. All product cleaning solvent and water generated by the operation, shall be transported by a transporter permitted under 6 NYCRR 364 and, if disposed of in NYS, disposed of at a site regulated by the NYSDEC.

3.03 PERMANENT CLOSURE OF UNDERGROUND STORAGE TANKS:

3.03.1 Access to the interior of the tanks shall be made through existing manholes. If the tanks do not have manholes, the Contractor shall excavate and provide an opening into the tank after purging. If the tanks are closed in place and permanently sealed with concrete, the Contractor shall repair the disturbed area to match the surrounding area.

3.03.2 The procedures for closing the tanks shall include, but not be limited to the following:

A. Remove all product that can be pumped out.
B. Drain and flush piping into the tanks.
C. Remove remaining liquid from the tanks.
D. All piping and gauge lines, with the exception of the vent lines, shall be disconnected and capped.
E. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors as described in Section 3.02 above.
F. The interior of the tanks shall be cleaned with a high pressure rinse.
G. The tanks shall be completely filled with concrete corresponding to NYCDOT Class B-32 as per Section 3.05 or removed and disposed of in accordance with API RP 1604.
H. The vent lines shall be capped at the tanks and all exposed piping removed and disposed of as approved by the Construction Manager.

I. If tanks are closed in place, all openings to the tanks including, but not limited to, fill boxes, manholes, and gauge boxes shall be filled with concrete flush with the finished floor.

J. If the tanks are not closed in place, the tanks shall be removed from the ground and disposed of properly.

3.04 REMOVAL OF UNDERGROUND STORAGE TANKS:

3.04.1 Access to the interior of the tanks shall be made through existing manholes. If the tanks do not have manholes, the Contractor shall excavate and provide an opening into the tank after purging.

3.04.2 The procedures for removing the tanks shall include, but not be limited to the following:

A. Remove all product that can be pumped out.
B. Drain and flush piping into the tanks.
C. Remove remaining liquid from the tanks.
D. All piping and gauge lines, with the exception of the vent lines, shall be disconnected and capped.
E. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors as described in Section 3.02 above.
F. The interior of the tanks shall be cleaned with a high pressure rinse.
G. The tanks shall be removed and disposed of in accordance with API RP 1604.
H. The vent lines shall be capped at the tanks and all exposed piping removed and disposed of as approved by the Construction Manager.

3.05 DISPOSAL OF EXCAVATED SOIL:

The Contractor shall assume all excavated soil as petroleum contaminated. Soil must be disposed of in accordance with applicable State and Federal regulations. The Contractor shall dispose of all petroleum contaminated soil at a facility which is permitted by the NYSDEC to accept such materials. The Contractor shall secure all permits required in connection thereof and provide the Construction Manager with all documentation regarding the disposal of such soil.

3.06 DISPOSAL OF PETROLEUM STORAGE TANKS:

All storage tanks containing petroleum liquids shall be removed in accordance with the requirements of Nassau County fire and police officials and those of the NYSDEC in general. All nonmetal tanks shall be disposed of (or recycled) at facilities permitted by the NYSDEC. Metal tanks shall be disposed of only by recycling.

3.07 EXCAVATION BACKFILL:

All backfill shall be clean and in accordance with Section 02210: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEM.

3.08 SITE ASSESSMENT:

A. General: The Construction Manager shall perform a site assessment to determine if there is any contamination present at the site. The Contractor shall assist with the site assessment as directed by the Construction Manager. The Contractor shall notify the Construction Manager at least 5 days prior to the day the Construction Manager is expected to be on-site for sampling operations. Any costs incurred due to delays caused

by the Contractor's failure to provide a minimum of five days' notice to the Construction Manager will be at the Contractor's expense.

B. Equipment: The Construction Manager will conduct drilling/sampling operations. The Contractor shall assist with the site assessment as directed by the Construction Manager.

C. Sampling Procedure for Tanks Removed: The Construction Manager will conduct sampling operations. In general, a minimum of five soil samples will be collected around each tank that is to be removed. Soil samples shall be taken from any area that appears to be visually contaminated. If there are no areas of visually contaminated soil then one sample from each side-wall of the excavation, two samples from the bottom of the excavation and two samples from a depth of 2 or 3 ft. below the bottom of the excavation will be collected. If groundwater is within 5 ft. of the bottom of the excavation, then a groundwater sample shall be taken. All samples collected for vapor contamination shall be screened using a PID or other approved instrument. The samples showing the highest vapor contamination shall be sent to the lab for analysis. If the PID does not indicate a relative difference in soil conditions across the site then one sample from each side wall and two samples from a depth of 2 to 3 ft. beneath the tank excavation shall be sent for lab analysis. Sample collection and lab analysis shall be conducted in accordance with subparagraph 3.08.D and 3.08.E, respectively.

D. Sample Collection. Sample collection shall be conducted in accordance with API Publication 1628.

E. Lab Analysis: Samples collected for analysis shall be sent to the Construction Manager's independent testing lab. For tanks containing gasoline, samples shall be analyzed using EPA Test Method 8021 plus methyl tert butyl ether (MTBE). For tanks containing diesel fuel, samples shall be analyzed for VOCs using EPA Method 8021 and SVOCs using EPA Method 8270.

3.09 TANK CLOSURE REPORT:

The Construction Manager shall prepare a Tank Closure Report for each UST site. The Contractor shall assist the Construction Manager with preparation of the Tank Closure Reports as directed by the Construction Manager. In addition, the Contractor shall assist the Construction Manager in obtaining information for inclusion in the Tank Closure Reports as directed by the Construction Manager. Tank Closure Reports shall include the following information as a minimum:

A. A cover letter signed by the Contractor's responsible company official certifying that all services involved have been performed in accordance with the terms and conditions of this Specification.

B. A narrative report describing what was encountered at each site, including:
   1. Condition of the UST
   2. Any visible evidence of leaks or stained soils
   3. Results of vapor monitoring readings
   4. Actions taken including quantities of material treated or removed
   5. Reasons for selecting sample locations
   6. Sample locations, depths, and collection methods
   7. Sample collection data such as time of collection and method of preservation
   8. Whether or not groundwater was encountered

9. Summary tables showing comparison of sample results to both NYSDEC STARS Memo #1 and NYSDEC TAGM #4046 requirements

C. Copies of all analyses performed for disposal. (Provided by Contractor)

D. Copies of all waste analyses or waste profile sheets. (Provided by Contractor)

E. Copies of all certification of final disposal signed by the responsible disposal facility official. (Provided by Contractor)

F. Information on who sampled, analyzed, transported, and accepted all waste encountered and copies of manifests. (Provided by Contractor)

G. Copies of all analyses performed for verification that underlying soil is not contaminated, with copies of chain-of-custody for each sample. All analyses shall give the identification number of the sample analyzed.

H. Scaled one-line drawings showing tank locations, limits of excavation, limits of contamination, underground utilities within 50 ft., sample locations, and sample identification numbers.

I. Progress Photographs: The Construction Manager shall take a minimum of four views of the site showing such things as the location of each tank, entrance/exit road, and any other notable site condition before work begins. After work has been started at the site, the Construction Manager shall photographically record activities at each work location daily. Photographs shall be 3-in. x 5-in. and shall include:

1. Soil removal, handling and sampling
2. Unanticipated events such as discovery of additional contaminated areas
3. Soil stockpile area
4. Tank
5. Fill placement and grading

J. Post-construction photographs. After completion of work at each site, the Construction Manager shall take a minimum of four views of the site. Prints shall illustrate the condition and location of work and the state of progress. The photographs shall be mounted and enclosed back-to-back in a double face plastic sleeve punched to fit standard three ring binders. Each color print shall show an information box, 1$\frac{2}{}$-in. x 3$\frac{2}{}$-in. The information box for the 3-in. x 5-in. photographs shall be scaled down accordingly, or taped to the bottom of the photo. The box shall be typewritten and arranged as follows:

Project No.:	Contract No.:
Location:	
Contractor:	
Photographer:	
Photograph No.:	Date/Time:
Description:	
Direction of View:	

END OF SECTION

SECTION 02081 - REMOVAL OF UNIVERSAL WASTE

1.1 GENERAL

A. Description Of Work

1. This specification covers the proper removal, storage, transportation and disposal of Universal Waste, which shall include removal of non-PCB fluorescent light ballasts, tubes, high intensity discharge lamps, batteries and mercury containing equipment. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Before Start of Work: Submit the following to the Owner's Representative for review (A-I). Do not start the work until these submittals are returned with Owner's Representative's approval.
   a. Copy of State or local license for hazardous waste hauler;
   b. Certification of at least one on-site supervisor which has satisfactorily completed the OSHA 40 Hour Health and Safety Course for Handling Hazardous Materials;
   c. Certificates of workers which have successfully completed at least the OSHA 40-Hour Health and Safety Course for Hazardous Materials;
   d. Certificates of workers which have successfully completed the required employee training for universal waste or appropriate type of training to the type of wastes being managed;
   e. Schedule of start and finish times and dates for this work;
   f. Name and address of the universal waste handler or a destination facility where the waste materials is to be treated, deposited or recycled in accordance with all regulatory requirements (include contact person and telephone numbers), if the universal waste meets the definition of hazardous waste, the name and address of the hazardous waste treatment, storage and disposal (TSD) facility;
   g. Material Safety Data Sheets for all materials requiring removal;
   h. If Contractor introduces any chemical into the work environmental, a MSDS for that chemical is required before use;
   i. Contingency Plan for handling emergency spills or leaks;
   j. Provide a copy of the NYS DEC Part 364 Waste Transporter permit for Universal Waste Transporters that transport more than 500 pounds of universal waste in a single shipment since they must be a permitted hazardous waste transporter.
   k. Large Quantity Handlers of universal waste must provide documentation of notification to the EPA and/or the appropriate local government agency in advance of its intentions to transport the waste and receive from the facility or provide an EPA identification number prior to exceeding 5,000 kilograms of waste on-site and
   l. Provide a record of all universal waste shipments received and sent offsite from the project.

C. Definitions

1. Large Quantity Handler (LQH) of Universal Waste shall be a waste handler who accumulates 5,000 kilograms or more of universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time. This designation as a large quantity handler of universal waste is retained through the end of the calendar year in which 5,000 kilograms (11,000 pounds) or more total of universal waste is accumulated. The LQH shall notify the EPA, acquire or co-ordinate with a facility regarding an EPA

identification number, and provide records for each shipment. The LQH shall ensure all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal facility operations and emergencies.

2. Small Quantity Handler of Universal Waste (SQH) shall be a waste handler who does not accumulate 5,000 kilograms (11,000 pounds) or more of total universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time.
3. Destination Facility shall be a facility that legitimately and can legally accept universal waste from offsite so that the universal waste can be treated, disposed, or recycled in accordance with the regulatory requirements.
4. Universal Waste Transporter shall be anyone who transports universal waste. In New York, universal waste transporters that transport greater than 500 pounds of universal waste in a single shipment must be a permitted hazardous waste transporter pursuant to Federal and State regulations. Proper notification with the receiving handler agreeing to receive the shipment is required by the Universal Waste Transporter.
5. Employee training shall ensure that all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal operations and emergencies and to the type of waste they are handling.
6. Universal Waste Regulations – Universal Waste Rule - 40 CFR Part 273, New York State – Standards for Universal Wastes 6 NYCRR Subpart 374-3.

1.2 PRODUCTS

A. Materials
1. Polyethylene Sheet: A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mil thick, clear, frosted, or black.
2. Duct Tape: Provide duct tape in 3" widths, witty an adhesive which is formulated to stick aggressively to sheet polyethylene.
3. Spray Cement: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.
4. Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags.
5. Labels: As required by the EPA and OSHA for handling, transportation, and disposal of hazardous waste.
6. Drums: Recovery or salvage drums acceptable for disposal of hazardous waste. Prior approval of drums is required. Drums or containers must meet the required OSHA EPA (40 CFR Parts 264265 and 300), and DOT regulations (49 CFR Parts 171-178). Use of damaged drums will not be allowed.

1.3 EXECUTION

A. Universal Waste
1. Once the properly labeled containers holding the universal waste have been filled and sealed, they shall be stored in designated accumulation areas as agreed upon by the Owners Representative and Contractor. They shall not be allowed to store in transportation vehicles, or onsite for more than one year from when the waste has been generated.
2. Documentation when a universal waste in storage was first accumulated shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the universal waste has been accumulated.

3. Maintenance of an inventory system on-site that identifies the earliest date that any universal waste in a group of universal waste items or a group of containers of universal waste became a waste was received.
4. Any waste developed from the work that exhibits one or more characteristics of hazardous waste must be handled accordingly and not as a universal waste.

B. Off-Site Shipment of Universal Waste
1. Off-Site shipments shall meet the requirements for offsite shipments and is prohibited from sending or taking universal waste to a place other than a designated universal waste handler or a universal waste destination facility.
2. LQH's of universal waste must notify EPA in writing and develop an EPA identification number or co-ordinate with the facility regarding use of their EPA identification number, prior to exceeding 5,000 kilograms of universal waste onsite.
3. SQH's do not need to notify EPA, receive and EPA identification number or deep records of shipments of universal waste.
4. LQH's must keep a record of all universal waste shipments received or sent offsite, and must retain those records for at least three years from the date of receipt or shipment. Records may include invoices, manifests, logs, bills or lading, or other shipping documents.

C. Storage Of Hazardous Waste (if required)
1. Once the properly labeled containers holding the hazardous waste have been filled and sealed, they shall be stored in designated areas as agreed upon by the Owners Representative and Contractor. They shall not be allowed to store the hazardous waste for more than the storage limitations relating to quantities stored and the length of time the material may be stored.
2. Documentation when a hazardous waste in storage was first stored shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the hazardous waste has been accumulated.
3. Maintenance of an inventory system on-site that identifies the earliest date that any hazardous waste was placed into proper storage.

D. Off-Site Shipment of Hazardous Waste
1. Off site shipments shall meet the requirements for offsite shipments and is prohibited from sending or taking hazardous waste to a place other than an authorized treatment, storage and disposal (TSD) facility.
2. An EPA identification shall be developed or provided by the facility.
3. A copy of the transporter's Part 364 Permit shall be provided to the Owner's Representative and the facility representative.
4. A copy of all waste manifests and any test results or waste analysis utilized for the off-site transportation and disposal shall be submitted to DASNY.

END OF SECTION 02081

SECTION 02082 - REMOVAL OF FLUORESCENT LIGHT BALLASTS

1.1 GENERAL

A. Description Of Work

This specification covers the furnishing and installation of materials for removal of fluorescent light ballasts from the Nassau County Police Fourth Precinct located at 1699 Broadway, Hewlett, New York. Products shall be as follows or as directed by Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work. The number of units that will be affected by the demolition of the Police Precinct is approximately 152 Ballasts.

1.2 SPECIAL JOB CONDITIONS

A. Any special job conditions, including variances obtained by the Owner, are described below.

1. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
2. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.
3. Working hours shall be as required and approved by the Owner. PCB material removal activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during 'off-hours' (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.
4. The Contractor shall assume that fluorescent light ballasts contain PCB capacitors and potting material unless ballast contains a "No PCBs" label.
6. If ballast contains a "No PCBs" label, the ballast may be recycled or disposed of as solid waste.

1.3 PERMITS AND COMPLIANCE

A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.

B. Storage and disposal of PCBs is regulated by the U.S. Environmental Protection Agency (EPA) under the Toxic Substances Control Act (TSCA) and 40 CFR Part 761. Any waste generated shall be bagged up and carried directly to an approved waste dumpster or container meeting the requirements for labeling, storage, and disposal. Wastes not

associated with ballast leakage may be segregated from wastes potentially impacted by leaking ballasts.

C. The Contractor shall handle, manage, and recycle or dispose of all PCB Ballasts in accordance with 40 CFR Part 761.50 and Part 761.62.

D. Perform PCB related Work in accordance with DEC Hazardous Waste Regulations (6 NYCRR 370-374, i.e. Hazardous Waste Rules), 40 CFR 761, and 29 CFR 1926, as specified herein. Where more stringent requirements are specified, adhere to the more stringent requirements.

E. The Contractor must maintain current licenses or registrations pursuant to DEC and EPA regulations for all Work related to this Project, including the removal, handling, transport, and disposal of hazardous and industrial waste.

F. The Contractor shall be prepared to obtain an EPA ID number if so directed by the Owner.

G. Failure to adhere to the Project Documents shall constitute a breach of the Contract and the Owner shall have the right to and may terminate the Contract provided, however, the failure of the Owner to so terminate shall not relieve the Contractor from future compliance.

1.4 Submittals

1. Before Start of Work: Submit the following to the Owner's Representative for review (A-. Do not start work until these submittals are returned with Owner's Representative's approval.
   a. Copy of State or local license for hazardous waste hauler;
   b. Certification of at least one on-site supervisor which has satisfactorily completed the OSHA 40 Hour Health and Safety Course for Handling Hazardous Materials;
   c. Certificates of workers which have successfully completed at least the OSHA 40-Hour Health and Safety Course for Hazardous Materials;
   d. Certificates of workers which have successfully completed the required employee training for universal waste or appropriate type of training to the type of wastes being managed;
   e. Schedule of start and finish times and dates for this work;
   f. Name and address of the universal waste handler or a destination facility where the waste materials is to be treated, deposited or recycled in accordance with all regulatory requirements (include contact person and telephone numbers), if the universal waste meets the definition of hazardous waste, the name and address of the hazardous waste treatment, storage and disposal (TSD) facility;
   g. Material Safety Data Sheets for all materials requiring removal;
   h. If Contractor introduces any chemical into the work environmental, a MSDS for that chemical is required before use;
   i. Contingency Plan for handling emergency spills or leaks;
   j. Provide a copy of the NYS DEC Part 364 Waste Transporter permit for Universal Waste Transporters that transport more than 500 pounds of universal waste in a single shipment since they must be a permitted hazardous waste transporter.
   k. Large Quantity Handlers of universal waste must provide documentation of notification to the EPA and/or the appropriate local government agency in advance of its intentions to transport the waste and receive from the facility or provide an EPA identification number prior to exceeding 5,000 kilograms of waste on-site and
   l. Provide a record of all universal waste shipments received and sent offsite from the project.

1.5. Definitions

1. PCB fluorescent light ballasts contain more than 50 ppm of PCBs.

2. Large Quantity Handler (LQH) of Universal Waste shall be a waste handler who accumulates 5,000 kilograms or more of universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time. This designation as a large quantity handler of universal waste is retained through the end of the calendar year in which 5,000 kilograms (11,000 pounds) or more total of universal waste is accumulated. The LQH shall notify the EPA, acquire or co-ordinate with a facility regarding an EPA identification number, and provide records for each shipment. The LQH shall ensure all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal facility operations and emergencies.

3. Small Quantity Handler of Universal Waste (SQH) shall be a waste handler who does not accumulate 5,000 kilograms (11,000 pounds) or more of total universal waste (batteries, pesticides, thermostats, or lamps, calculated collectively) at any time.

4. Destination Facility shall be a facility that legitimately and can legally accept universal waste from offsite so that the universal waste can be treated, disposed, or recycled in accordance with the regulatory requirements.

5. Universal Waste Transporter shall be anyone who transports universal waste. In New York, universal waste transporters that transport greater than 500 pounds of universal waste in a single shipment must be a permitted hazardous waste transporter pursuant to Federal and State regulations. Proper notification with the receiving handler agreeing to receive the shipment is required by the Universal Waste Transporter.

6. Employee training shall ensure that all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal operations and emergencies and to the type of waste they are handling.

1.2 PRODUCTS

A. Materials

1. Polyethylene Sheet: A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mil thick, clear, frosted, or black.
2. Duct Tape: Provide duct tape in 3" widths, witty an adhesive which is formulated to stick aggressively to sheet polyethylene.
3. Spray Cement: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.
4. Disposal Bays: Provide 6 mil thick leak-tight polyethylene bags.
5. Labels: As required by the EPA and OSHA for handling, transportation, and disposal of hazardous waste.
6. Drums: Recovery or salvage drums acceptable for disposal of hazardous waste. Prior approval of drums is required. Drums or containers must meet the required OSHA EPA

(40 CFR Parts 264265 and 300), and DOT regulations (49 CFR Parts 171-178). Use of damaged drums will not be allowed.

1.3 EXECUTION

A. Universal Waste
1. Once the properly labeled containers holding the universal waste have been filled and sealed, they shall be stored in designated accumulation areas as agreed upon by the Owners Representative and Contractor. They shall not be allowed to store in transportation vehicles, or onsite for more than one year from when the waste has been generated.
2. Documentation when a universal waste in storage was first accumulated shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the universal waste has been accumulated.
3. Maintenance of an inventory system on-site that identifies the earliest date that any universal waste in a group of universal waste items or a group of containers of universal waste became a waste was received.
4. Any waste developed from the work that exhibits one or more characteristics of hazardous waste must be handled accordingly and not as a universal waste.

B. Off-Site Shipment of Universal Waste
1. Off-Site shipments shall meet the requirements for offsite shipments and is prohibited from sending or taking universal waste to a place other than a designated universal waste handler or a universal waste destination facility.
2. LQH's of universal waste must notify EPA in writing and develop an EPA identification number or co-ordinate with the facility regarding use of their EPA identification number, prior to exceeding 5,000 kilograms of universal waste onsite.
3. SQH's do not need to notify EPA, receive and EPA identification number or deep records of shipments of universal waste.
4. LQH's must keep a record of all universal waste shipments received or sent offsite, and must retain those records for at least three years from the date of receipt or shipment. Records may include invoices, manifests, logs, bills or lading, or other shipping documents.

C. Storage Of Hazardous Waste (if required)
1. Once the properly labeled containers holding the hazardous waste have been filled and sealed, they shall be stored in designated areas as agreed upon by the Owners Representative and Contractor. They shall not be allowed to store the hazardous waste for more than the storage limitations relating to quantities stored and the length of time the material may be stored.
2. Documentation when a hazardous waste in storage was first stored shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the hazardous waste has been accumulated.
3. Maintenance of an inventory system on-site that identifies the earliest date that any hazardous waste was placed into proper storage.

D. Off-Site Shipment of Hazardous Waste

1. Off site shipments shall meet the requirements for offsite shipments and is prohibited from sending or taking hazardous waste to a place other than an authorized treatment, storage and disposal (TSD) facility.
2. An EPA identification shall be developed or provided by the facility.
3. A copy of the transporter's Part 364 Permit shall be provided to the Owner's Representative and the facility representative.
4. A copy of all waste manifests and any test results or waste analysis utilized for the off-site transportation and disposal shall be submitted to DASNY.

END OF SECTION 02082

SECTION 02 0110 - PROTECTION OF EXISTING CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. Work of this section, as shown or specified, shall provide Protection of existing conditions in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.02 WORK INCLUDED

A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
   1. Protection of existing conditions during construction operations.
   2. Repair of any damage during construction operations.

1.03 PROJECT CONDITIONS

A. Structures to be demolished will be discontinued in use and vacated prior to start of work.

B. Nassau County Department of Public Works (NCDPW assumes no responsibility for condition of structures to be demolished.

C. Conditions existing at the time of inspection for bidding purposes will be protected by NCDPW as reasonably practical.

D. Unless otherwise indicated in Contract Documents or specified by the NCDPW, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.

E. Explosives shall not be brought to site or used without written consent of NCDPW. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

1.04 CONTRACTOR RESPONSIBILITIES

A. General coordination with other trades, NCDPW, etc.

B. During construction, contractor is responsible for protecting existing conditions that are to remain as necessary.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.06 PERMITS AND APPROVALS

A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by NCDPW. Copies of all permits shall be supplied to the NCDPW prior to the commencement of work authorized by the permit.

1.07 PROJECT RECORD DOCUMENTS

A. Upon completion of the work of this and related sections, the contractor shall provide the NCDPW with an as-built survey, tied into established project benchmarks. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site-work items, with the approval of the NCDPW. Marked-up design plans are not acceptable for the requirements of this section. All survey elevations shall be in North American Vertical Datum (NAVD88).

B. The contractor shall accurately record any structures which exist on site and are not shown on the contract documents.

C. A pre-construction and post-construction survey of the conditions within the project limits to remain during construction shall be performed by the Contractor and provide to the NCDPW.

1.08 RELATED SECTIONS AND DOCUMENTS

A. Project Specifications:
1. Section 021000 – Protection of Existing Utilities
2. Section 310000 – Earthwork
3. Section 312500 – Erosion and Sedimentation Controls

B. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract.

1.09 REFERENCE STANDARDS

A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

PART 2 EXECUTION

2.01 GENERAL DEMOLITION REQUIREMENTS

A. Demolish site improvements designated to be removed as shown on the contract drawings and specifications. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage, landscaping, etc.

B. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.

2.02 FILLING VOIDS

A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, septic tanks, wells, cisterns, etc., using general fill materials as defined in Section 310000.

B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.

C. Grade surface per the contract documents and to provide flow of surface drainage after fill placement and compaction.

2.03 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish, and other materials resulting from demolition operations from site. Leave areas of work in clean condition.

B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate governing authority and NCDPW. If allowed as stated above, burning shall be performed in a manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.

C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and NCDPW.

2.04 PROTECTION

A. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures within the project area. Contractor shall not damage any of those that are to remain and shall leave them accessible.

B. Monuments, bench marks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, the Contractor shall have them replaced at own expense.

C. Flag, barricade or suitably protect existing conditions during construction operations and equipment movement.

D. Provide any other safety measures and follow any additional procedures requested by the NCDPW.

2.05 DAMAGE

A. Any damage to existing conditions by the Contractor or his subcontractors shall be immediately repaired with the least impact to the operational standards. If the repairs are not immediately addressed by the Contractor, the Commissioner will contract for the repair at the Contractor's expense.

B. Post construction condition surveys shall be conducted by the Contractor. Any damage to the site shall be repaired to the condition identified in the preconstruction survey. The NCDPW shall determine the acceptability of any repairs.

END OF SECTION

SECTION 021000 - PROTECTION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Work of this section, as shown or specified, shall provide protection of existing utilities in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.02 WORK INCLUDED

A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
   1. Identification and field mark-out of all on-site utility lines within the project limits to remain in operation and/or be relocated during construction.
   2. Protection and support of utilities during construction operations.
   3. Repair of any damage during construction operations.

1.03 CONTRACTOR RESPONSIBILITIES

A. General coordination with other trades, NCDPW, etc.

B. Notify affected utility companies and Owner before starting work and comply with their requirements.

C. Contractor is responsible for protecting existing utilities during construction as necessary.

1.04 PERMITS AND APPROVALS

A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by NCDPW. Copies of all permits shall be supplied to the NCDPW prior to the commencement of work authorized by the permit.

B. Connections with existing utilities shall be performed in accordance with the requirements of the Owner or Agency of the utility. The Contractor shall be required to comply with all such requirements, including securing all permits, and payment of all permit and/or connection fees.

1.05 PROJECT RECORD DOCUMENTS

A. Upon completion of the work of this and related sections, the contractor shall provide the NCDPW with an as-built survey of all new water, sewer, electric, telecommunication, and gas service lines. The data shall include invert elevations at the property line and at connection point to existing utility infrastructure, tied into established project benchmarks. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site-work items, with the approval of NCDPW. Marked-up design plans are not acceptable for the requirements of this section. All survey elevations shall be in North American Vertical Datum (NAVD88).

B. The contractor shall accurately record any structures which exist on site and are not shown on the contract documents.

C. A pre-construction and post-construction survey of the condition of all utilities within the project limits to remain during construction shall be performed by the Contractor.

D. The Contractor shall provide a survey of the actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.06 RELATED SECTIONS AND DOCUMENTS

A. Project Specifications:
1. Section 020110 – Protection of Existing Conditions
2. Section 310000 – Earthwork
3. Section 312500 – Erosion and Sedimentation Controls
4. Section 330000 – Other Utilities
5. Section 331000 – Water Utilities
6. Section 333000 – Sanitary and Storm Sewerage Utilities

B. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract.

C. Project Documents: (not used)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 IDENTIFICATION

A. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work. In the event of identifying and unforeseen conflict/condition, notify the Owner immediately.

B. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

C. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by the Owner and Construction Manager and then only after acceptable temporary utility services have been provided.

3.02 PROTECTION

A. Prior to commencement of any work, consult the records for existing utilities, and note all conditions and limitations, which might affect the work.

B. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures and utilities within the project area. Contractor shall not damage any of those that are to remain and shall leave them accessible.

C. The work shall be executed so that no damage or injury will occur to existing public and adjoining or adjacent structures, streets, paving, sewers, gas, water, electric or any other pipes. Should any damage or injury caused by the Contractor, or anyone in the Contractor's employ, or by the work under this Contract occur, the Contractor shall, at his own expense, make good such damage and assume all responsibility for such injury.

D. The above shall also include the protection of all existing utilities (including, but not limited to sewers, water lines, gas lines, electrical lines and telecommunication lines) to remain in use within and adjacent to the area affected by the work of the project.

E. Monuments, bench marks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, the Contractor shall have them replaced at their own expense.

F. Flag, barricade or suitably protect existing utilities during construction operations and equipment movement.

G. At a minimum, Contractor shall provide timber mats at locations where equipment will cross existing utilities. Provide any other safety measures and follow any additional procedures requested by the NCDPW and the utility owner.

3.03 DAMAGE

A. Any damage to existing utilities by the Contractor or his subcontractors shall be immediately repaired with the least impact to the utility service and to the operational standards. If the repairs are not immediately addressed by the Contractor, the utility owner and/or the NCDPW will contract for the repair at the Contractor's expense.

B. Post construction condition surveys shall be conducted by the Contractor. Any damage to the utilities shall be repaired to the condition identified in the preconstruction survey. The NCDPW and/or utility owner shall determine the acceptability of any repairs.

END OF SECTION

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SECTION 02150

REMOVAL AND DISPOSAL OF INDUSTRIAL WASTE

PART 1 - GENERAL

1.01 SCOPE OF WORK:

The Contractor shall furnish all labor, tools, equipment and materials required to perform all operations necessary for removal and disposal of industrial waste (residual contents inside the tank) from the site as required by the Contract Documents.

1.02 RELATED WORK:

SECTION 01495: SPILL PREVENTION AND CONTROL
SECTION 02070: REMOVAL OF UNDERGROUND STORAGE TANKS

1.03 SUBMITTALS:

A. The Contractor shall submit for approval the proposed methods, equipment and the Plan of Operations for the removal of industrial waste from the tanks and piping system.

B. The Contractor shall submit an affidavit of tank storage system purging and cleaning as required in Paragraph 3.03.

C. Health & Safety Plan

1.04 PROCEDURES:

A. Waste removal operations shall not commence without prior authorization of the Construction Manager.

B. The proposed procedures for removal of industrial waste shall provide for safe conduct of the work, careful removal and disposal of materials, and protection of the existing adjacent structures. The procedure shall include a detailed description of the methods and equipment to be used for each operation, and sequence of operation.

C. Safety Precautions. Removal work shall not start until the readings from the explosion meter indicate, that a safe and non-explosive tank atmosphere has been achieved as evidenced by readings of less than 10% of the lower explosive or flammable level at all elevations within the tank. Removal work shall be progressed diligently and expeditiously without interruption until its completion. The explosion meter shall be used to take subsequent readings periodically or continuously as directed by the Construction Manager as work is progressing. If any reading indicates a dangerous level is approaching, work shall cease, the workers shall exit the tank, and additional carbon dioxide shall be introduced into the tank until safe conditions are restored to all levels within the tank.

D. The Contractor shall permit only trained and properly equipped personnel to enter the tank. Tanks shall not be entered unless personnel have and use proper self contained breathing apparatus and standby personnel similarly equipped are present at the site to safeguard and protect those working in the tank. Workers in the tank shall also have and use appropriate harnesses and lifelines connected to personnel retrieval equipment fully rigged, and ready for use.

1.05 PROTECTION OF PERSONS AND PROPERTY:

A. Structures and facilities within the area of operations under this Contract shall be protected. Any disturbance or damage to the work, or any impairments of facilities resulting directly or indirectly from the Contractor's operations, shall be properly restored, repaired or replaced at the Contractor's expense to the satisfaction of the Construction Manager.

B. The Contractor shall provide temporary barricades and protection where required to prevent damage to facilities, new work and injury to personnel.

1.06 SPILL PREVENTION:

Any release to the environment of tank contents or cleaning liquids shall be cleaned up immediately by the Contractor to the satisfaction of the Construction Manager at no cost to the City. Spill prevention measures shall be fully described in the Spill Prevention and Control Plan.

1.07 REMOVED MATERIALS:

Except as otherwise set forth in these Specifications or as limited by the Construction Manager, all removed materials shall become the property of the Contractor who shall promptly remove them from the work site and dispose of the same. Storage of removed materials within the work site will not be permitted.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 TANK CONTENTS REMOVAL:

A. Salvageable petroleum products. All salvageable petroleum products shall be transferred by the Contractor to other tanks as approved by the Construction Manager. If storage capacity is not available, then salvageable petroleum products become the property of the Contractor for beneficial use or disposal at no additional expense to the City.

B. Sludge Material (Temporary Storage). Sludge shall be collected in new or reconditioned 55-gallon drums or roll-off containers supplied by the Contractor. Drums or containers shall be sealed water-tight to prevent rain infiltration and leaking of sludge and stored on-site in such a manner that the contents will not spill or leak. Chemical sampling and analyses of sludge shall be conducted and paid for by the Contractor in accordance with environmental regulatory requirements, as approved by the Construction Manager. Analytical results shall be provided to the Construction Manager within five (5) working days after receipt of results. Drums or containers shall be labeled in accordance with federal and State Regulations.

C. Contaminated Water. Contaminated water shall be collected in new or reconditioned 55-gallon drums or roll-off containers supplied by the Contractor. Drums or containers shall be sealed water-tight to prevent rain infiltration and leaking of water. Drums or containers shall be stored on-site in such a manner that the contents will not spill or leak. Chemical sampling and analysis

of water shall be conducted and paid for by the Contractor in accordance with the environmental regulatory requirements, as approved by the Construction Manager. Analytical results shall be provided to the Construction Manager within five (5) working days after receipt of results. Drums or containers shall be labeled in accordance with federal and State Regulations. Before the removal of any tank is begun, it shall first be pumped completely dry. All water shall be transported and disposed of in accordance with applicable laws. All product shall be disposed of according to applicable laws. During the emptying operation the following restrictions shall apply:

1. Smoking shall be banned in the area
2. All open flame and spark producing equipment within the area shall be shut down
3. All electrical and internal combustion equipment, unless designated to be "Explosion Proof" shall be removed
4. Only "non-sparking" tools shall be used
5. Static electricity shall be controlled
6. The work area shall be secured

3.02 DISPOSAL OF INDUSTRIAL WASTE MATERIALS:

A. All applicable requirements of the USEPA, NYSDEC, NYCDEP and any other governing body having jurisdiction shall be followed. The Contractor shall assume the responsibility for the safe and proper removal of all waste materials and the disposal of such waste off the site at a licensed waste disposal facility with the approval of the Construction Manager.

B. All fees, transportation costs and special precautions are the responsibility of the Contractor. The Contractor shall bear full responsibility for any and all fines or assessments levied against the Project due to improper handling and disposal of the waste material.

3.03 CLEANING OF TANK:

The Contractor shall provide an explosion meter to monitor the tank atmosphere before, during and after the cleaning and purging procedures. All tanks shall be cleaned of all residue and product clinging to their surfaces. The tank storage system, including all tanks and piping, shall be purged of flammable vapors. Steam shall not be used for either purging or cleaning a tank or other equipment. An affidavit of such purging, signed by the Contractor's licensed underground system installer, shall be filed by the Contractor with the Nassau County Fire Marshall, Division of Fire Prevention. The Contractor shall comply with all OSHA requirements and regulations. All product, cleaning solvents and water generated by the operation, shall be transported by a transporter permitted under 6NYCRR 364 and if disposed of in NYS, disposed of at a site regulated by the NYSDEC.

END OF SECTION

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SECTION 024116

STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Division 1, Section 017419 - Construction Waste Management and Disposal

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of building.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.

1.3 DEFINITIONS

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

1.4 MATERIALS OWNERSHIP

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

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Contractor to review salvageable items with the Owner prior to demolition.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.
2. Review and finalize protection requirements.
3. Review procedures for noise control and dust control.
4. Review procedures for protection of adjacent buildings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

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

D. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Shutoff and capping of utility services.

E. Pre-demolition Photographs or Video: Show existing conditions of adjoining or adjacent construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Hazardous Materials: It is expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by the contractor before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

D. On-site storage or sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
3. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

B. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.

C. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building 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 trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

D. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

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

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

SECTION 02 65 00 - UNDERGROUND STORAGE TANK REMOVAL

PART 1 - GENERAL

1.01 SCOPE OF WORK:

The Contractor shall furnish all labor, equipment, tools and materials required to perform all operations necessary to properly remove soils, dispose of tank contents, residues, contaminated soils and debris and remove and dispose of or permanently close in place underground storage tanks by filling with concrete, as required by the Contract Documents or as required by the Construction Manager.

1.02 APPLICABLE REFERENCES:

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only and shall be the latest published versions.

A. American Petroleum Institute (API)

API Publ 1628	Assessment and Remediation of Underground petroleum Releases
API RP 2015	Cleaning Petroleum Storage Tanks
API RP 1604	Removal and Disposal of Used Underground Petroleum Storage Tanks

B. Petroleum Equipment Institute (PEI)

PEI RP 1200	Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities

C. Environmental Protection Agency (EPA)

EPA 8260C	Volatile Organic Compounds by Gas Chromatography/Mass Spectometry (GC/MS)
EPA 8270D	Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)
EPA 40 CFR Part 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks
EPA 40 CFR Part 281	Approval of State Underground Storage Tank Programs

D. Nassau County Department of Health
Nassau County Public Health Ordinance Article XI

1.04 PERMIT AND LICENSE REQUIREMENTS:

Prior to the start of work under this Contract, any permits or licenses required to perform the work shall be obtained by the Contractor at the Contractor's own cost and expense. Determining license and permit requirements shall be the responsibility of the Contractor.

A. Nassau County Department of Health (NCDH)

The Contractor shall make written notifications to NCDH in accordance with the requirements of Article XI sections 20, 21, and 22 regulations. The Contractor shall obtain written approval from NCDH prior to proceeding with work that requires NCDH notification and inspections.

1.05 PROTECTION OF EXISTING STRUCTURES AND UTILITIES:

All necessary precautions shall be taken to assure that no damage occurs to existing structures and appurtenances, and utilities to remain in place. Any buried utilities encountered which are not shown on the Contract Drawings, marked out by the Contractor, or otherwise indicated, shall be reported immediately to the Construction Manager and shall not be disturbed without prior approval of the Construction Manager.

1.06 SPILL PREVENTION:

Any releases to the environment of tank contents or cleaning liquids shall be cleaned up immediately and remediated by the Contractor, as approved by the Construction Manager at no cost to the County or the Construction Manager.

1.07 DIGGING PERMITS AND ROAD AND/OR PARKING LOT CLOSINGS:

The Contractor shall obtain all necessary base excavation (digging and road/parking for closing) permits from the Nassau County Public Works Department before starting any excavation work on this project. The Contractor shall allow at least fourteen (14) calendar days from date of written application to receive permission to dig and to partially close roads and/or parking lots.

1.08 REMOVED MATERIAL:

Except as otherwise set forth in these Specifications or as limited by the Construction Manager, all removed materials shall become the property of the Contractor who shall promptly remove them from the work site and dispose of the same in accordance with Part 3 of this Section. Storage of removed material within the work site will not be permitted.

1.09 SUBMITTALS:

A. Plan of Operations. A Plan of Operations shall be prepared and submitted to the Construction Manager for approval within seven (7) business days after the date of Notice to Proceed. The plan shall describe methods, equipment, and sequences of operations, including, but not limited to:

1. Soil excavation and disposal
2. Tank contents removal
3. Spill prevention
4. Exploratory excavations
5. Tank purging procedure
6. Interior and exterior tank cleaning procedure
7. Wastewater collection and disposal
8. Facility to perform analyses
9. Permanent closure in place of underground storage tank, as appropriate
10. Anticipated use, recycling or disposal of contents
11. Soil/Groundwater Sampling procedure

12. Backfilling compaction and grading
13. Disposal of petroleum storage tanks
14. Safety and health plan

Work shall not be started until the plan has been approved by the Construction Manager and NCDH.

B. Chemical Data Acquisition Plan: A Chemical Data Acquisition Plan (CDAP) for sampling of soil and groundwater to be disposed of off-site shall be provided to the Construction Manager and NCDH prior to the start of work.

C. Results of Testing: Documentation of the soil and groundwater disposal sampling performed, including analytical results, shall be provided to the Construction Manager and to the NCDH.

D. Waste Manifests. Copies of manifests required to transport any waste materials shall be furnished to the Construction Manager not later than the day following their preparation.

E. Documentation of Treatment or Disposal. Documentation of acceptance of waste materials by a facility legally permitted to treat or dispose of those materials shall be furnished to the Construction Manager not later than seven (7) calendar days following delivery of those materials to the facility.

F. Letters of acceptance from the facility and haulers acknowledging agreement to accept the waste material shall be furnished to the Construction Manager not more than fourteen (14) calendar days before transporting any hazardous or toxic materials.

1.10 TANK DESCRIPTIONS:

A. Locations: General locations of all tanks are shown on the Contract Drawings. Specific locations of tanks shall be defined by exploratory excavations performed by the Contractor. The cost of exploratory investigations shall be borne by the Contractor.

B. Tank Contents: Tanks have been used for storage of petroleum products.

PART 2 - PRODUCT

(Not Used)

PART 3 - EXECUTION

3.01 REMOVAL OF UNDERGROUND STORAGE TANKS:

A. Petroleum storage tanks shall be removed in accordance with the requirements of the Nassau County Public Health Ordinance (NCPHO).

B. Access to the interior of the tanks shall be made through existing manholes. If the tanks do not have manholes, the Contractor shall excavate and provide an opening into the tank after purging.

C. The procedures for removing the tanks shall include, but not be limited to the following:
1. Remove all product that can be pumped out.
2. Drain and flush piping into the tanks.

3. Remove remaining liquid from the tanks.
4. All piping and gauge lines, with the exception of the vent lines, shall be disconnected and capped.
5. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors as described in Section 3.04 below.
6. The interior of the tanks shall be cleaned with a high pressure rinse.
7. The tanks shall be removed and disposed of in accordance with API RP 1604.
8. The vent lines shall be capped at the tanks and all exposed piping removed and disposed of as approved by the Construction Manager and NCDH.

3.02 CLEANING OF TANK:

A. Prior to removal and disposal, all tanks shall be cleaned of all residue and product clinging to their surfaces. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors. Storage tanks shall be cleaned in accordance with API RP 2015. Steam shall not be used for either purging or cleaning a tank or other equipment. An affidavit of such purging, signed by the UST system installer, shall be filed by the Contractor with the Construction Manager.

B. The Contractor shall comply with all OSHA requirements and regulations. All product, cleaning solvent, and water generated by the operation, shall be properly transported under NCDH regulations. Transportation and disposal shall be at no additional cost to the County or the Construction Manager.

C. Remaining product, sludge and contaminated water shall be properly disposed of.

D. Safety Precautions

1. Removal work shall not start until the readings from the explosion meter indicate that a safe and non-explosive tank atmosphere has been achieved as evidenced by readings less than ten percent (10%) of the lower explosive limit or flammable level at all elevations within the tank. The Contractor shall provide a four (4) gas meter to monitor the tank atmosphere before, during and after the cleaning and purging procedures.

2. Removal work shall be progressed diligently and expeditiously without interruption until its completion. The explosion meter shall be used to take subsequent readings continuously as directed by the Construction Manager as work is progressing. If any reading indicates a dangerous level is approaching, work shall cease, the workers shall exit the tank, and the tank purged until safe conditions are restored to all levels within the tank.

3. Tanks are to be considered confined space entry, unless the tank is altered during this process to render it no longer confined space entry. If confined space, entry procedures must follow confined space entry procedures. Confined space entry shall be performed only by properly trained and certified personnel.

4. The Contractor shall permit only trained and properly equipped personnel to enter the tank. Tanks shall not be entered unless personnel have and use proper self-contained breathing apparatus and standby personnel similarly equipped are present at the site to safeguard and protect those working in the tank. Workers in the tank shall also have and use appropriate harnesses and lifelines connected to personnel retrieval equipment fully rigged, and ready for use.

3.03 DISPOSAL OF EXCAVATED SOIL:

The Contractor shall assume all excavated soil as petroleum contaminated. Soil must be properly disposed of in accordance with applicable local, State and Federal regulations. The Contractor shall properly dispose of all petroleum-contaminated soil at a facility which is permitted by the NCDH to accept such materials. The Contractor shall secure all permits required in connection thereof and provide the Construction Manager with all documentation regarding the disposal of such soil.

3.04 DISPOSAL OF PETROLEUM STORAGE TANKS:

All nonmetal tanks shall be disposed of (or recycled) at facilities permitted by the NCDH. Metal tanks shall be disposed of only by recycling.

3.05 EXCAVATION BACKFILL:

All backfill shall be clean and in accordance with the contract drawings.

3.06 SITE ASSESSMENT:

A. General: The Engineer shall perform a site assessment to determine if there is any contamination present at the site. The Contractor shall assist with the site assessment as directed by the Construction Manager. The Contractor shall notify the Construction Manager at least five (5) business days prior to the day the Engineer is expected to be on-site for sampling operations. Any costs incurred due to delays caused by the Contractor's failure to provide a minimum of five (5) business days' notice to the Construction Manager will be at the Contractor's expense.

B. Equipment: The Engineer will conduct drilling/sampling operations. The Contractor shall assist with the site assessment as directed by the Construction Manager.

C. Sampling Procedure for Tanks Removed: In general, a minimum of eight (8) soil samples and one groundwater sample (if present) will be collected around each tank that is to be removed. Soil samples shall be taken from any area that appears to be visually contaminated. If there are no areas of visually contaminated soil then the following samples will be collected: one (1) sample from each sidewall of the excavation, two (2) samples from the bottom of the excavation and two samples from a depth of 2 or 3 ft. below the bottom of the excavation will be collected. If groundwater is within 5 ft. of the bottom of the excavation, then a groundwater sample shall be taken. All samples collected for vapor contamination shall be screened using a PID or other approved instrument. The samples showing the highest vapor contamination shall be sent to the lab for analysis. If the PID does not indicate a relative difference in soil conditions across the site then one sample from each sidewall and two samples from a depth of 2 to 3 ft. beneath the tank excavation shall be sent for lab analysis. Sample collection and lab analysis shall be conducted in accordance with subparagraph 3.08.E and 3.08.F, respectively.

D. Sample Collection: Sample collection shall be conducted in accordance with NYSDEC STARS Memo No. 1, Petroleum-Contaminated Soil Guidance Policy, CP-51 Soil Cleanup Guidance Policy and the NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation, from the limits of the excavation upon completion of the UST removal. If groundwater is present in the open excavation, a groundwater grab sample will be collected for laboratory analysis.

E. Lab Analysis: Samples collected for analysis shall be sent to the Engineer's independent testing lab. Samples shall be analyzed for VOCs in accordance with EPA Method 8260, and SVOCs in

accordance with EPA Method 8270 for the list of fuel constituents specified in Table 2 and Table 3 of the NYSDEC CP-51 soil cleanup guidance document.

F. All tank closure information and records must be provided to the Construction Manager no more than 15 days from the date of tank closure. This information shall include the items listed in paragraph 1.09 parts C, D, and F of this section.

3.07 TANK CLOSURE REPORT:

The Engineer shall prepare a Tank Closure Report for each UST site. The Contractor shall assist the Engineer with preparation of the Tank Closure Reports as directed by the Construction Manager. In addition, the Contractor shall assist the Engineer in obtaining information for inclusion in the Tank Closure Reports as directed by the Construction Manager. Tank Closure Reports shall include the following information as a minimum:

A. A cover letter signed by the Contractor's responsible company official certifying that all services involved have been performed in accordance with the terms and conditions of this Specification.

B. A narrative report describing what was encountered at each site, including:

1. Condition of the UST
2. Any visible evidence of leaks or stained soils
3. Results of vapor monitoring readings
4. Actions taken including quantities of material treated or removed
5. Reasons for selecting sample locations
6. Sample locations, depths, and collection methods
7. Sample collection data such as time of collection and method of preservation
8. Whether or not groundwater was encountered
9. Summary tables showing comparison of sample results to NYSDEC CP-51 Soil Cleanup Guidance and/or NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) (if required).

C. Copies of all analyses performed for disposal. (Provided by Contractor)

D. Copies of all waste analyses or waste profile sheets. (Provided by Contractor)

E. Copies of all certification of final disposal signed by the responsible disposal facility official. (Provided by Contractor)

F. Information on who sampled, analyzed, transported, and accepted all waste encountered and copies of manifests. (Provided by Contractor)

G. Copies of all analyses performed for verification that underlying soil is not contaminated, with copies of chain-of-custody for each sample. All analyses shall give the identification number of the sample analyzed.

H. Scaled one-line drawings showing tank locations, limits of excavation, limits of contamination, underground utilities within 50 ft., sample locations, and sample identification numbers.

I. Progress Photographs: The Construction Manager shall take a minimum of four views of the site showing such things as the location of each tank, entrance/exit road, and any other notable site condition before work begins. After work has been started at the site, the Construction Manager shall photographically record activities at each work location daily. Photographs shall be copied onto a USB portable flash drive, and shall include:

1. Soil removal, handling and sampling
2. Unanticipated events such as discovery of additional contaminated areas
3. Soil stockpile area
4. Tank
5. Fill placement and grading

J. Post-construction photographs. After completion of work at each site, the Construction Manager shall take a minimum of four views of the site. Photos shall illustrate the condition and location of work and the state of progress. Photographs shall be appropriately named and copied onto a USB portable flash drive and given to the Construction Manager at project completion.

END OF SECTION 02 65 00

SECTION 02 82 00

ASBESTOS REMOVAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This asbestos abatement Project will consist of the removal and disposal of asbestos-containing materials (ACMs) and presumed asbestos-containing materials (PACMs) at the NCPD 2nd Precinct Station House, located at 7700 Jericho Turnpike, Woodbury, NY.

B. The work shall include but not be limited to the removal of the following materials:

Floor/ Level / Location	Work Area Designation	Description of Asbestos Materials	Removal Method(s)	Approximate Quantity (SF/Unit)
Lower Level	1	Boiler Breeching, Cementitious	56-7.11	60.0 SF
		Exterior Door Caulking	56-11.6	8.0 SF
		Interior and Exterior Window Caulking and Glazing	56-11.6	81.0 SF
		All Layers of Floor Tiles and Mastic	56-11.7	3,479.0 SF
		Mud Joint Packing	56-7.11	150.0 LF
		Black Waterproofing Tar on Face Brick	56-11.6	4,620.0 SF
		Assumed ACM Transite Piping	56-7.11	50.0 LF
		Assumed ACM Non-Fiberglass Pipe and Pipe Fitting Insulation	56-7.11	150.0 LF
		Assumed ACM Ceiling Plenum Debris	56-7.11	300.0 SF
1st Floor	2	Exterior Door Caulking	56-11.6	6.0 SF
		Interior and Exterior Window Caulking and Glazing	56-11.6	193.5 SF
		All Layers of Floor Tiles and Mastic	56-11.7	3,808.0 SF
		Mud Joint Packing	56-7.11	150.0 LF
		Black Waterproofing Tar on Face Brick	56-11.6	4,620.0 SF
		Assumed ACM Non-Fiberglass Pipe and Pipe Fitting Insulation	56-7.11	150.0 LF
		Assumed ACM Ceiling Plenum Debris	56-7.11	300.0 SF
Total Quantity (SF/LF/Units)				**17,475.5 SF 650.0 LF**

C. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

D. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.

E. Working hours shall be as required and approved by the Owner. Asbestos abatement activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during 'off-hours' (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.

1.02 SPECIAL JOB CONDITIONS

A. Any special job conditions, including Variances obtained by the Owner, are described below:

1. ALL WORK SHALL BE PERFORMED IN STRICT ACCORDANCE WITH THE PROJECT DOCUMENTS AND NYS ICR 56, WHERE CONFLICTS OCCURS BETWEEN THE PROJECT DOCUMENTS AND APPLICABLE CODES, RULES AND REGULATIONS, THE MOST STRINGENT SHALL APPLY.
2. THE CONTRACTOR SHALL COORDINATE LOCATIONS OF DECONTAMINATION UNITS, EGRESS ROUTES, AND WASTE CONTAINER WITH THE OWNER'S REPRESENTATIVE(S). IN CASE LOCATIONS THAT ARE MORE APPROPRIATE FOR THE DECONTAMINATION UNIT ARE DETERMINED AT ANY TIME DURING THE ABATEMENT, THEY MAY BE RELOCATED.
3. THE CONTRACTOR SHALL DEFINE, AS PART OF THEIR PROJECT SPECIFIC WORK PLAN, THE LOCATION OF ACCESSIBLE TEMPORARY POWER AND WATER SUPPLY IN COORDINATION WITH THE OWNER'S REPRESENTATIVE. ALL TEMPORARY POWER CONNECTIONS SHALL BE DETERMINED THROUGH THE GENERAL CONTRACTOR. THE TEMPORARY ELECTRICAL CONNECTIONS REFERENCED ON THE DRAWINGS ARE NOT THE OFFICIAL LOCATIONS.
4. ALL MATERIALS SHALL BE REMOVED COMPLETELY DOWN TO THE SUBSTRATE, TO A SURFACE THAT IS FREE AND CLEAR OF ALL RESIDUES AND MADE SUITABLE FOR REPLACEMENT MATERIALS. ABATEMENT CONTRACTOR SHALL LEAVE CLEAN DEMARCATIONS AT THE BORDERS OF REMOVALS TO FACILITATE REPLACEMENT MATERIALS.
5. ANY SUSPECT MATERIALS DISCOVERED DURING CONSTRUCTION THAT HAVE NOT BEEN ADDRESSED BY PREVIOUS SURVEY INFORMATION, SHALL REQUIRE TESTING BY THE OWNER'S ENVIRONMENTAL CONSULTANT.
6. THE CONTRACTOR SHALL CONFIRM THE LOCATION AND QUANTITY OF ALL ACM PRIOR TO BIDDING AND IS RESPONSIBLE FOR THE PREPARATION AND SECURING OF ALL PROJECT FILINGS SUCH AS US EPA AND NYS DOL.
7. ANY ASSUMED ACM MAY BE TESTED DURING ABATEMENT BY THE OWNER'S ENVIRONMENTAL CONSULTANT TO ASSESS ITS TRUE ASBESTOS CONTENT, IF ANY.
8. ABATEMENT CONTRACTOR SHALL BE RESPONSIBLE FOR INSPECTING ALL CEILING PLENUM SPACES FOR PIPE INSULATION, PIPE FITTING INSULATION, AND ASSOCIATED DEBRIS. ANY SUCH MATERIALS FOUND WILL NEED TO BE ABATED

AND THE PLENUM SPACES CLEANED OF ALL DEBRIS. THIS WORK SHALL BE PERFORMED THROUGHOUT THE ENTIRE BUILDING'S CEILING PLENUMS.

9. ALL PIPE CHASES, WET WALLS, AND SIMILAR SPACES SHALL BE OPENED UNDER ABATEMENT PROCEDURES AND INSPECTED FOR THE ASSUMED ACM PIPE AND PIPE FITTING INSULATION. ANY SUCH ACM FOUND WILL NEED TO BE ABATED.
10. ABATEMENT CONTRACTOR SHALL BE REQUIRED TO PERFORM SELECTIVE DEMOLITION OF THE BUILDING EXTERIOR FACE BRICK TO EXPOSE THE WATERPROOFING WITHIN THE CAVITY BEHIND SUCH MATERIALS.
11. THE ABATEMENT CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING PHASING OF WORK AND RELATED ESTABLISHMENT OF REGULATED WORK AREAS ON EACH FLOOR.
12. ABATEMENT CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING ALL FLOOR TILES DOWN TO THE SUBSTRATE. NO TILE OR MASTIC REMNANTS SHALL BE PERMITTED TO REMAIN AFTER THE ABATEMENT.

1.03 PERMITS AND COMPLIANCE

A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.

B. Perform asbestos related Work in accordance with New York State Industrial Code Rule 56 (herein referred to as Code Rule 56), 40 CFR 61, and 29 CFR 1926. Where more stringent requirements are specified, adhere to the more stringent requirements.

C. The Contractor must maintain current licenses, permits and certifications pursuant to New York State Department of Labor and Department of Environmental Conservation for all Work related to this Project, including the removal, handling, transport, and disposal of asbestos-containing materials.

D. The Contractor must maintain current licenses pursuant to New York State Department of Labor, and New York State Department of Environmental Conservation for all Work related to this Project, including the removal, handling, transport, and disposal of asbestos-containing materials.

E. The Contractor must have and submit proof upon request that any persons employed by the Contractor to engage in or supervise Work on any asbestos Project have valid NYS asbestos handling and supervisor certificates pursuant to Code Rule 56 regulations.

F. The Contractor shall be responsible for obtaining all other Variances as may be required for the Project or as requested by the Owner. Approval of the Owner is required prior to submission of a Variance application to any regulatory agency. Failure to obtain Owner approval may result in Owner not permitting variance to be used on the Project.

G. The Contractor shall be responsible for compliance with The New York State Uniform Fire Prevention and Building Code, or its successor during all Work at the site.

H. Failure to adhere to the Project Documents shall constitute a breach of the Contract and the Owner shall have the right to and may terminate the Contract provided, however, the failure of the Owner to so terminate shall not relieve the Contractor from future compliance.

1.04 SUBMITTALS

A. Pre-Work Submittals: Within 7 days prior to the pre-construction conference, the Contractor shall submit an electronic copy of the documents listed below to the Owner's Project Manager and the Environmental Consultant for review and approval prior to the commencement of asbestos abatement activities::

1. Contractor license issued by New York State Department ofLabor.
2. A list of Projects performed within the past two (2) years and include the dollar value of all Projects. Provide Project references to include Owner, Environmental Consultant, and air monitoring firm's name, contact persons, address, and phonenumber.
3. Progress Schedule:
   a. Show the complete sequence of abatement activities for each work area and the sequencing of Work within each building or building section listed in the contract.
   b. Show the dates and hours of work for the beginning and completion of each major element of Work for wall work areas including substantial completion dates for each Work Area, building, or phase.
4. Project Notifications (original and all amendments in chronological order): As required by Federal and State regulatory agencies together with proof of transmittal (i.e. certified mail return receipts). NYS DOL Site Specific Variance or Applicable Variance, ifapplicable.
5. Building Occupant Notification: Provide the following information, as required by regulatory agencies:
   a. Owner, Site Name and Address, Building, Asbestos Project Location at Building, Start and End Dates.
   b. Quantity and type of material to be removed.
   c. Asbestos Contractor Name, Address, Contact Name and Phone Number, NYSDOL License Number.
   d. Third Party Air Monitor Name, Address, Contact Name and Phone Number, NYSDOL License Number.
   e. Air Monitoring Laboratory Name, Address, Contact Name and Phone Number, New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) Number.
   f. NYSDOL Regional Office Phone Number.
   g. OWNER Project Manager Name and PhoneNumber.
   h. General Contractor Project Manager Name and Phone Number, if applicable
6. Abatement Work Plan and Drawing(s): Provide a written work plan description of work and drawing(s) that clearly indicates the following:
   a. All work areas/containments numbered sequentially.
   b. Locations and types of all decontamination enclosures for each workarea.
   c. Entrances and exits to each work areas/containments.
   d. Type of abatement activity/technique for each workarea/containment.
   e. Number and location of negative air units and exhaust for each work area, when applicable. Also provide calculations for determining number of negative air pressure units.
   f. Proposed location and construction of storage facilities and field office.
   g. Location of water and electrical connections to building services for each work area/containment.
   h. Waste transport routes through the building, or exterior to the waste storage container for each work area/containment.
7. Disposal Site/Landfill Permit from applicable regulatory agency.
8. Transfer Facility Permit (if used) from applicable regulatory agency.
9. Valid Waste Transporter NYS Part 364 permit for all transporters.

10. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
11. Valid US DOT vehicle permits for all Transporters.
12. Special Waste Characterization Profile, if required by the disposal site/landfill.
13. Current ELAP Certificate for laboratory performing analysis of OSHA personal air monitoring samples. Refer to Section 1.09.

B. On-Site Submittals: Refer to Part 3.01.B, C, D and E for all submittals, documentation, and postings required to be maintained on-site during abatement activities.

C. Project Close-out Submittals: Within 30 days of the completion of each abatement phase, the **Abatement Contractor** shall submit an electronic copy of the documents listed below to OWNER and the Environmental Consultant for review and Code Compliance approval prior to Contractor's final payment. Once OWNER approves the close-out submittal, the Contractor shall provide 3 hard copy sets of the approved close-out documents (double-sided and bound) to OWNER Project Management for appropriate distribution, including 1 set to be distributed to the facility and 1 set (with original waste records) to Code Compliance.
1. All Waste Shipment Records and Waste Shipment Record Logs (**Original** Waste Shipment Record(s) shall be sent to OWNER).
2. OSHA compliance air monitoring records (laboratory reports and chain of custodies) conducted during the Work (compiled in chronological order).
3. Daily progress log, and the Work Area entry/exit log(s).
4. Supervisor and Handlers/Workers NYS DOL Asbestos (current at time of asbestos abatement) Certifications.
5. Contractor licensed issued by New York State Department of Labor.
6. Disposal Site/Landfill Permit from applicable regulatory agency.
7. Transfer Facility Permit (if used) from applicable regulatory agency.
8. Valid Waste Transporter NYS Part 364 permit for all transporters.
9. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
10. Valid US DOT vehicle permits for all Transporters.
11. Special Waste Characterization Profile, if required by the disposal site/landfill.
12. Current ELAP Certificate for laboratory performing analysis of OSHA personal air monitoring samples. Refer to Section 1.09.
13. EPA and NYS DOL Regulatory Project notifications and amended notifications, along with proof of transmittals, and NYS DOL Site-Specific Variances/Applicable Variances.

D. Project Close-out Submittals: Within 30 days of the completion of the abatement phase, the **Environmental Consultant** shall submit 1 electronic copy of the closure report, including the documents listed below to OWNER for review and approval. Once OWNER approves the final closeout submittals, the Environmental Consultant shall provide 3 hard copy sets of the approved submittals (double-sided and bound) to OWNER Project Management for appropriate distribution, including 1 set to be distributed to the facility and 1 set to Owner.
1. Upon completion of the Project, the Environmental Consultant shall certify to the Owner, in writing, that the work is complete, acceptable and was performed in compliance with the Project Documents and all Local, State and Federal Regulation in an Executive Summary of the work.
2. The Environmental Consultant shall review and approve or disapprove all necessary guarantees, certificates of compliance, and all other close-out documentation, which the Asbestos Contractor is required to submit.

3. The Environmental Consultant shall provide to the Owner the final/closeout project report which must include
    a. Consultant license issued by New York State Department of Labor.
    b. Project Monitor(s) Certificate issued by New York State Department of Labor.
    c. All daily logs and daily worker/handler rosters.
    d. Summary of all visual inspections with the date of inspection and the date of signoff on the supervisor's log.
    e. Air sampling logs, final lab reports (no drafts-must be signed by analyst and reviewer), chain of custody forms, and sample location plans.
    f. Copies of Waste Shipment Records and Waste Shipment Record Logs.
    g. EPA and NYS DOL Regulatory Project notifications, amended notifications, along with proof of transmittals and NYS DOL Site-Specific Variances/Applicable Variances, if applicable.
    h. All pertinent correspondence related to the Project, including re-occupancy letters and elevated air results submission to NYS DOL documentation per 56-4.10 (a).

1.05 PRE-CONSTRUCTION CONFERENCE

A. Prior to start of preparatory Work under this Contract, the Contractor shall attend a pre-construction conference attended by Owner, Facility Personnel, and Environmental Consultant.

B. Agenda for this conference shall include but not necessarily be limited to:
    1. Contractor's scope of Work, Work plan, and schedule to include number of workers and shifts.
    2. Contractor's safety and health precautions including protective clothing and equipment and decontamination procedures.
    3. Environmental Consultant's duties, functions, and authority.
    4. Contractor's Work procedures including:
        a. Methods of job site preparation and removal methods.
        b. Respiratory protection.
        c. Disposal procedures.
        d. Cleanup procedures.
        e. Fire exits and emergency procedures.
    5. Contractor's required pre-work and on-site submittals, documentation, and postings.
    6. Contractor's plan for twenty-four (24) hour Project security both for prevention of theft and for barring entry of unauthorized personnel into Work Areas.
    7. Temporary utilities.
    8. Handling of furniture and other movable objects.
    9. Storage of removed asbestos-containing materials.
    10. Waste disposal requirements and procedures.

C. In conjunction with the conference the Contractor shall accompany the Owner and Environmental Consultant on a pre-construction walk-through documenting existing condition of finishes and furnishings, reviewing overall Work plan, location of fire exits, fire protection equipment, water supply and temporary electric tie-in.

1.06 APPLICABLE STANDARDS AND REGULATIONS

A. The Contractor shall comply with the following codes and standards, except where more stringent requirements are shown or specified:

B. Federal Regulations:
   1. 29 CFR 1910.1001, "Asbestos" (OSHA)
   2. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
   3. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
   4. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)
   5. 29 CFR 1926, "Construction Industry" (OSHA)
   6. 29 CFR 1926.1101, "Asbestos, Tremolite, Anthophyllite, and Actinolite" (OSHA)
   7. 29 CFR 1926.500 "Guardrails, Handrails and Covers" (OSHA)
   8. 40 CFR 61, Subpart A, "General Provisions" (EPA)
   9. 40 CFR 61, Subpart M, "National Emission Standard for Asbestos" (EPA)
   10. 49 CFR 171-172, Transportation Standards (DOT)

C. New York State Regulations:
   1. 12 NYCRR, Part 56, "Asbestos", Industrial Code Rule 56 (DOL) (amended March 21, 2007).
   2. 6 NYCRR, Parts 360, 364, Disposal and Transportation (DEC)
   3. 10 NYCRR, Part 73, "Asbestos Safety Program Requirements" (DOH)

D. Standards and Guidance Documents:
   1. American National Standards Institute (ANSI) Z88.2, Practices for Respiratory Protection
   2. ANSI Z9.2-79, Fundamentals Governing the Design and Operation of Local Exhaust Systems
   3. EPA 560/585-024, Guidance for Controlling Asbestos-containing Materials in Buildings (Purple Book)
   4. EPA 530-SW-85-007, Asbestos Waste Management Guidance
   5. ASTM Standard E1368 “Standard Practice for Visual Inspection of Asbestos Abatement Projects.”

1.07 NOTICES

A. The Contractor shall provide notification of intent to commence asbestos abatement activities as indicated below.

   1. At least ten (10) Working days prior to beginning abatement activities, send written notification to:

      U.S. Environmental Protection Agency Region 2
      National Emissions Standards for Hazardous Air Pollutants (NESHAPS) Coordinator
      Air Branch
      290 Broadway, 21st Floor
      New York, NY 10007-1866

   2. At least ten (10) calendar days prior to beginning abatement activities send written notification to:

      New York State Department of Labor
      Division of Safety and Health, Asbestos Control Program
      State Office Campus
      Building 12 - Room 161B
      Albany, NY 12240

B. The Contractor is required to send notifications to U.S. Environmental Protection Agency and New York State Department of Labor via mail or package delivery service that will provide proof of delivery and receipt.

C. The Contractor shall be responsible for maintaining current project filings with regulatory agencies for the duration of the project.

D. The Contractor shall post and/or provide Building Occupant Notification at least 10 calendar days prior to beginning abatement activities as required by Code Rule 56.

1.08 PROJECT MONITORING AND AIR SAMPLING

A. The Owner shall engage the services of an Environmental Consultant who shall serve as the Owner's Representative in regard to the performance of the asbestos abatement Project and provide direction as required throughout the entire abatement Project period. The Environmental Consultant and all subconsultants shall not have any contractual relationship with the Contractor for the duration of the asbestos project.

B. The Contractor is required to ensure cooperation of its personnel with the Environmental Consultant for the air sampling and Project monitoring functions described in this section. The Contractor shall comply with all direction given by the Environmental Consultant during the course of the Project.

C. The Environmental Consultant shall provide the following administrative services:
   1. Review and approve or disapprove all submittals, shop drawings, schedules, and samples.
   2. Assure that all notifications to governmental agencies by the Contractor are submitted in a timely manner and are correct in content.

D. The Environmental Consultant shall staff the Project with a trained and certified person(s) to act on the Owner's behalf at the job site. This individual shall be designated as the Abatement Project Monitor (APM).
   1. The APM shall be on-site at all times the Contractor is on-site. The Contractor shall not be permitted to conduct any Work unless the APM is on-site (except for inspection of barriers and negative air system during non-working days).
   2. The APM shall have the authority to direct the actions of the Contractor verbally and in writing to ensure compliance with the Project documents and all regulations. The APM shall have the authority to Stop Work when gross Work practice deficiencies or unsafe practices are observed, or when ambient fiber concentrations outside the removal area are equal to or greater than 0.01 f/cc or background level, whichever is greater.
      a. Such Stop Work order shall be effective immediately and remain in effect until corrective measures have been taken and the situation has been corrected.
      b. Standby time, re-cleaning time, and air sample collection time and analysis cost required to resolve the situation shall be at the Contractor's expense.
      c. The Environmental Consultant shall track and provide a summary of standby, re-cleaning, and/or air sampling time to achieve satisfactory clearance, as well as a summary of any equipment used. These summaries shall be provided to the OWNER Project Manager.
   3. The APM shall provide the following services:
      a. Inspection of the Contractor's Work, practices, and procedures, including temporary protection requirements, for compliance with all regulations and Project specifications including provisions required by Variances, the Work Place Safety Plan and Asbestos Work Permit.
      b. Provide abatement Project air sampling as required by applicable regulations and the Owner. Sampling will include background, work area preparation, asbestos handling, final cleaning and aggressive clearance air sampling.

c. Verify daily that all Workers used in the performance of the Project are certified by the appropriate regulatory agency and include a worker roster in the daily log.
d. Monitor the progress of the Contractor's work and report any deviations from the schedule to the Owner.
e. Monitor, verify, and document all waste load-out operations.
f. Verify that the Contractor is performing personal air monitoring daily, and that results are being returned and posted at the site as required.
g. The APM shall maintain a daily log on site that documents all project related and Environmental Consultant and Contractor actions, activities, and occurrences.
h. Verify landfill to be used for waste disposal with waste transporter (driver) and Contractor prior to waste trailer/hardtop dumpster leaving site. Confirm the waste transporter firm and landfill are listed on the regulatory notifications for the project and the waste transport vehicle license number is listed on the current NYS DEC Waste Transporter permit.

4. The following minimum inspections shall be conducted by the APM, accompanied by the Contractor's supervisor. Additional inspections shall be conducted as required by Project conditions and/or at the owner's direction. Progression from one (1) phase of Work to the next by the Contractor is only permitted with the written approval of the APM.
   a. Pre-Construction Inspection: The purpose of this inspection is to verify the existing conditions of the Work Areas and to document these conditions.
   b. Pre-Commencement Inspection: The purpose of this inspection is to verify the integrity of each containment system prior to disturbance of any asbestos-containing material. This inspection shall take place only after the Work Area is fully prepped for removal.
   c. Work Inspections: The purpose of this inspection is to monitor the Work practices and procedures employed on the Project and to monitor the continued integrity of the containment system. Inspections within the removal areas shall be conducted by the APM during all preparation, removal, and cleaning activities at least twice every Work shift. Additional inspections shall be conducted as warranted.
   d. Pre-Encapsulation Inspection: The purpose of this inspection is to ensure the complete removal of Asbestos-Containing Material (ACM), from all surfaces in the Work Area prior to encapsulation.
   e. Visual Clearance Inspection: The purpose of this inspection is to verify that: all materials in the scope of work have been properly removed; no visible asbestos debris/residue remains; no pools of liquid or condensation remains; and all required cleanings are complete. This inspection shall be conducted before final air clearance testing.
   f. Post-Clearance Inspection: The purpose of this inspection is to ensure the complete removal of ACM, including debris, from the Work Area after satisfactory final clearance sampling and removal of all isolation and critical barriers and equipment from the Work Area.
   g. Punch List Inspection: The purpose of this inspection is to verify the Contractor's certification that all Work has been completed as contracted and the existing condition of the area prior to its release to the Owner.

E. The Environmental Consultant shall provide abatement Project air sampling and analysis as required by applicable regulations. Sampling will include, but is not limited to, background, work area preparation, asbestos handling, and final cleaning and clearance air sampling.
   1. Unless otherwise required by applicable regulations, the Environmental Consultant shall have samples analyzed by Phase Contrast Microscopy (PCM). Results shall be available at the Project site within 24 hours of completion of sampling.

2. Samples shall be collected as required by applicable regulations and these specifications. If Transmission Electron Microscopy (TEM) clearance air sampling is utilized by the owner, the clearance criteria and sampling protocols must be in compliance with AHERA. 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, provided that a standard NIOSH/ELAP accepted laboratory analysis method is utilized that shall report each air sample result in fibers per cubic centimeter.
3. If the air sampling during any phase of the abatement project reveals airborne fiber levels at or above 0.01 fibers/cc or the established background level, whichever is greater, outside the regulated Work Area, Work shall stop immediately and corrective measures required by applicable regulations shall be initiated. Notify OWNER project personnel, as well as all employers and occupants in adjacent areas. The Contractor shall bear the burden of any and all costs incurred by this delay.
4. The Environmental Consultant shall submit copies of all elevated air sampling results collected during abatement and all elevated final air clearance results to the Commissioner of Labor, as required by regulation.
5. A minimum of 1,200 Liters for PCM air samples or 1,300 Liters for TEM air samples (whichever is applicable) shall be collected at a flow rate between 2 and 10 liters per minute (L/min) as necessary to achieve proper sample collection and work practice duration.

1.09 CONTRACTOR AIR SAMPLING

A. In addition to the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring **every Work shift in each Work Area** during which abatement activities occur in order to determine that appropriate respiratory protection is adequate and is being worn and utilized. Negative Exposure Assessments are not allowed to be used in lieu of personal air monitoring.

B. The Contractor shall conduct air sampling that is representative of both the 8-hour time weighted average and 30-minute short-term excursion level exposures to indicate compliance with the OSHA Permissible Exposure Limits (PELs).

C. The Contractor's laboratory analysis of air samples shall be conducted by an NYS DOH ELAP approved laboratory. The Environmental Consultant shall not collect or analyze the Contractor’s air samples.

D. Results of personal air sample analyses shall be available, verbally, within twenty-four 24 hours of sampling and results with associated chains of custody shall be posted upon receipt and documented in the supervisor’s daily log book. Written laboratory reports shall be delivered and posted at the Work site within five (5) days. Failure to comply with these requirements may result in all work being stopped until compliance is achieved.

1.10 PROJECT SUPERVISOR

A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:
   1. The Project Supervisor shall hold New York State DOL certification as an Asbestos Supervisor.
   2. The Project Supervisor shall meet the requirements of a "Competent Person" as defined by OSHA 1926.1101 and shall have a minimum of one (1) year experience as a supervisor.
   3. The Project Supervisor must be able to speak, read, and write English fluently, as well as communicate in the primary language of the Workers.

B. If the Project Supervisor is not on-site at any time whatsoever, all Work shall be stopped. The Project Supervisor shall remain on-site until the Project is complete. The Project Supervisor cannot be removed

from the Project without the written consent of the Owner and the Environmental Consultant. The Project Supervisor shall be removed from the Project if so requested by the Owner.

C. The Project Supervisor shall maintain the bound Daily Project Log and separate work area entry/exit logs for each work area, as required by applicable regulations and section 2.03 of the specifications and the Waste Shipment Record Log required by section 4.03 of the specifications.

D. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the primary point of contact for the Abatement Project Monitor.

1.11 MEDICAL REQUIREMENTS

A. Before exposure to airborne asbestos fibers, provide Workers with a comprehensive medical examination as required by 29 CFR 1910.1001, and 29 CFR 1926.1101.
   1. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001, and 29 CFR 1926.1101 within the past year.
   2. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within thirty 30 calendar days before or after the termination of employment in such occupations.

1.12 TRAINING

A. As required by applicable regulations, prior to assignment to asbestos Work instruct each employee with regard to the hazards of asbestos, safety and health precautions, and the use and requirements of protective clothing and equipment.

B. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134, and 29 CFR 1926.1101. Provide respirator training and fit testing.

1.13 RESPIRATORY PROTECTION

A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH).

B. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual. Fit-test records shall be maintained on site for each employee.

C. Where fiber levels permit, and in compliance with regulatory requirements, Powered Air Purifying Respirators (PAPRs) are the minimum allowable respiratory protection permitted to be utilized during gross removal operations of OSHA Class I or OSHA Class II friable ACM.

D. No respirators shall be issued to personnel without such personnel participating in a respirator training program.

E. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.

F. A storage area for respirators shall be provided by the Contractor in the clean room side of the personal decontamination enclosure where they will be kept in a clean environment.

G. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters will be removed and discarded during the decontamination process. Filters cannot be reused. Filters must be changed if breathing becomes difficult.

H. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour work day. Any loose respirator filters found within the regulated area, must be disposed of as RACM asbestos waste.

I. Any authorized visitor, worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site and shall not be permitted to return.

J. The Contractor shall have at least two (2) Powered Air Purifying Respirators stored on site designated for authorized visitors use. Appropriate respirator filters for authorized visitors shall be made available by the Contractor.

1.14 DELIVERY AND STORAGE

A. Deliver all materials to the job site in original packages with containers bearing manufacturer's name and label.

B. Store all materials at the job site in a suitable and designated area.
   1. Store materials subject to deterioration or damage away from wet or damp surfaces and under cover.
   2. Protect materials from unintended contamination and theft.
   3. Storage areas shall be kept clean and organized.

C. Remove damaged or deteriorated materials from the job site. Materials contaminated with asbestos shall be disposed of as asbestos debris as herein specified.

1.15 TEMPORARY UTILITIES

A. Shut down and lock out all electrical power to the asbestos Work Areas, including lighting circuits. Any electrical power passing through the Work Areas that can't be shut down due to health and safety reasons, shall be protected as per the requirements of applicable regulations and shall not be utilized within the work area.

B. Provide temporary 120-240 volt, single phase, three (3) wire, 100 amp electric service with Ground Fault Circuit Interrupters (GFCIs) for all electric requirements within the asbestos Work Area.
   1. Where available, obtain from Owner's existing system. Otherwise provide power from other sources (i.e. generator).
   2. Provide temporary wiring and "weatherproof" receptacles in sufficient quantity and location to serve all HEPA equipment and tools.
   3. Provide wiring and receptacles as required by the APM for air sampling equipment.
   4. All power to the Work Area shall be brought in from outside the area through GFCI's at the source.

C. Provide temporary lighting with "weatherproof" fixtures for all Work Areas including decontamination chambers.
   1. The entire Work Area shall be kept illuminated at all times.
   2. Provide lighting as required by the Environmental Consultant for the purposes of performing required inspections.

D. All temporary devices and wiring used in the Work Area shall be capable of decontamination procedures including HEPA vacuuming and wet-wiping.

E. Utilize domestic water service, if available, from Owner's existing system. Provide hot water heaters with sufficient capacity to meet Project demands.

PART 2 PRODUCTS

2.01 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, gloves and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber for comfort, but shall not be used alone. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape, or provide disposable coverings with elastic wrists or tops.

B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.

C. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.

D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

2.02 SIGNS AND LABELS

A. Provide warning signs and barrier tapes at all approaches to asbestos Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.

   1. Provide danger signs in vertical format conforming to 29 CFR 1926.1101, minimum 20" x 14" displaying the following legend.

DANGER
ASBESTOS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
AUTHORIZED PERSONNEL ONLY
WEAR RESPIRATORY PROTECTION AND
PROTECTIVE CLOTHING IN THIS AREA

2. Provide 3" wide red barrier tape printed with black lettered, "DANGER ASBESTOS REMOVAL". Locate barrier tape across all corridors, entrances and access routes to asbestos Work Area. Install tape 3' to 4' above finished floor (AFF).

B. Provide asbestos danger labels affixed to all asbestos materials, scrap, waste, debris and other products contaminated with asbestos.

1. Provide asbestos danger labels of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
DO NOT BREATHE DUST
AVOID CREATING DUST

2. Provide the following asbestos labels, of sufficient size to be clearly legible, for display on waste containers (bags or drums) which will be used to transport asbestos contaminated material in accordance with United States Department of Transportation 49 CFR Parts 171 and 172:

RQ, NA2212, RACM ASBESTOS, 9, PGIII

3. Generator identification information shall be affixed to each waste container or any packaging used to containerize RACM asbestos waste indicating the following printed in indelible ink:

Generator Name
Facility Name
Facility Address
Date

2.03 DAILY PROJECT LOG & WORK AREA (Worker Decontamination Unit) ENTRY/EXIT LOG

A. Provide a bound Daily Project Log. The log shall contain on title page the Project name, name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; emergency numbers including, but not limited to local Fire/Rescue department and all other regulatory requirements.

B. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.

C. All persons entering and exiting the Work Area shall sign the Work Area (entry/exit log located in the decontamination unit clean room or airlock to the work area) and include name, certification number, and time.

D. The Project Supervisor shall document all work performed daily and note all regulatory required inspections, maintain entry log records and ensure that they are recorded in accordance with the provisions of all applicable regulations.

2.04 SCAFFOLDING AND LADDERS

A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole

or outrigger type or cantilever type. All scaffolding shall be designed and constructed in accordance with OSHA, and any other applicable federal, state and local government regulations. Whenever there is a conflict or overlap of the above references the most stringent provisions are applicable.

B. Provide scaffolding and ladders as required by the Environmental Consultant for the purposes of performing required inspections.

2.05 SURFACTANT (AMENDED WATER)

A. Wet all asbestos-containing materials prior to removal with surfactant mixed and applied in accordance with manufacturer's printed instructions.

2.06 ENCAPSULANT

A. Encapsulant shall be tinted or pigmented so that application when dry is readily discernible.

B. The encapsulant solvent or vehicle shall not contain a volatile hydrocarbon.

2.08 WASTE DISPOSAL BAGS, DRUMS, AND CONTAINERS

A. Provide 6 mil polyethylene disposal bags printed with asbestos caution labels. Bags shall also be imprinted with U.S. Department of Transportation required markings.

B. Provide 30 or 55 gallon capacity fiber, plastic, or metal drums capable of being sealed air and water tight if asbestos waste has the potential to damage or puncture disposal bags. Affix asbestos caution labels on lids and at one-third points around drum circumference to assure ready identification.

C. Containers and bags must be labeled in accordance with 40 CFR Part 61 NESHAPS and applicable regulations. When the bags/containers are moved to the lockable hardtop dumpster from the waste decontamination system washroom, the bags must also be appropriately labeled with the date they are moved on the bag/container in waterproof markings.

D. Labeled ACM waste containers or bags shall not be used for non-ACM waste or trash. Any material placed in labeled containers or any material placed in bags, whether the bag is turned inside out or not, shall be handled and disposed of as RACM waste.

2.09 HEPA VACUUM EQUIPMENT

A. All vacuuming performed under this contract shall be performed with High Efficiency Particulate Air (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.

B. Provide tools and specialized equipment including scraping nozzles with integral vacuum hoods connected to a HEPA vacuum with flexible hose.

2.10 POWER TOOLS

A. Any power tools used to drill, cut into, or otherwise disturb asbestos material shall be manufacturer equipped with HEPA filtered local exhaust ventilation

2.11 FIRE RETARDANT POLYETHYLENE SHEETING

A. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, waste container) shall be at least 6 mil fire retardant sheeting.

B. Decontamination enclosure systems shall utilize at least 6 mil opaque fire retardant plastic sheeting. At least two (2) layers of 6 mil reinforced fire retardant plastic sheeting shall be used for the flooring.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Should visible emissions or water leaks be observed outside the Work Area, immediately stop Work and institute emergency procedures per applicable regulations. Should there be elevated fiber levels outside the Work Area, immediately stop Work and institute emergency procedures per applicable regulations. All costs incurred in decontaminating such non-Work Areas and the contents thereof shall be borne by the Contractor, at no additional cost to the Owner.

B. Current medical surveillance approval, fit test reports, Contractor's Worker Acknowledgments, and valid NYS DOL Asbestos Handler certification cards shall be on site prior to admittance of any Contractor's employees to the asbestos Work Area.

C. Hard Copies of the following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Abatement Project Monitor:
   1. Valid Contractor license issued by New York State Department of Labor.
   2. Certification, Worker Training, Medical Surveillance, Acknowledgment(s):
      a. NYS DOL Asbestos Handler certification cards for each person employed in the removal, handling, or disturbance of asbestos.
      b. Evidence that Workers have received proper training required by the regulations and the medical examinations required by OSHA 29 CFR 1926.1101.
      c. Documentation that Workers have been fit tested specifically for respirators used on the Project.
   3. Daily OSHA personal air monitoring results.
   4. NYS Department of Health ELAP certification for the laboratory that will be analyzing the OSHA personal air samples.
   5. Disposal Site/Landfill Permit from applicable regulatory agency.
   6. Transfer Facility Permit (if used) from applicable regulatory agency.
   7. Valid Waste Transporter NYS Part 364 permit for all transporters.
   8. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
   9. Valid US DOT vehicle permits for all Transporters.
   10. Current ELAP Certificate for laboratory performing analysis of OSHA personal air monitoring samples
   11. Special Waste Characterization Profile, if required by the disposal site/landfill.
   12. Regulatory Project notifications and amended notifications.
   13. Applicable regulations.
   14. Safety Data Sheets of supplies/chemicals used on the Project.
   15. Approved Abatement Work Plan.
   16. List of emergency telephone numbers.

17. Magnahelic manometer semi-annual calibration certification.
18. Waste Shipment Record Log.
19. Daily Project Log.
20. Work Area Entry/Exit Logs, for each personal decontamination unit.
21. Contract documents (environmental survey report, specifications and drawings).

D. A floor plan showing the areas of the building under abatement and the location of all fire exits in said areas shall be prominently posted in the building lobby or comparable location, along with a notice stating the location within the building of the negative air cutoff switch required under applicable regulations.

E. Hard Copies of the following documentation shall be maintained on-site by the Abatement Project Monitor during abatement activities:
1. Valid Contractor license issued by New York State Department of Labor.
2. Air Sample Log.
3. Air sample laboratory results with chain of custody and sample location plans.
4. Project monitor daily log and a daily list of workers/supervisors onsite.
5. A copy of ASTM Standard E1368 "Standard Practice for Visual Inspection of Asbestos Abatement Projects."
6. Calibration Chart for rotometer(s) used on-site.
7. Project documents (environmental survey report, specifications and drawings).

F. The Work Area must be vacated by building occupants prior to decontamination enclosure construction and Work Area preparation.

G. All demolition necessary to access asbestos-containing materials for removal must be conducted within negative pressure enclosures by licensed asbestos handlers. Demolition debris may be disposed of as construction and demolition debris provided the Abatement Project Monitor determines that it is not contaminated with asbestos and there has been no disturbance of ACM within the enclosure. If the demolition debris is determined to be contaminated or ACM has been disturbed, it must be disposed of as RACM asbestos waste.

3.02 PERSONAL DECONTAMINATION ENCLOSURE

A. Provide personal decontamination enclosure contiguous to the Work Area or as per Variance. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed and sheathed to prevent unauthorized entry.

B. Access to the Work Area will be from the clean room through an airlock to the shower and through an airlock to the equipment room. Each airlock shall be a minimum of three (3) feet from door to door. Additional airlocks shall be provided as required by applicable regulations for remote decontamination enclosures.

C. The decontamination enclosure ceiling and walls shall be covered with one (1) layer of opaque 6 mil fire retardant polyethylene sheeting. Two (2) layers of reinforced 6 mil fire retardant polyethylene sheeting shall be used to cover the floor.

D. The entrance to the clean room shall have a lockable door along with adequate small openings for Work Area make-up air. Provide suitable lockers for storage of Worker's street clothes. Storage for respirators along with replacement filters and disposable towels shall also be provided.

E. Provide a temporary shower with individual hot and cold water supplies and faucets. Provide a sufficient supply of soap and shampoo. There shall be one (1) shower for every six Workers. The shower room shall be constructed in such a way so that travel through the shower chamber shall be through the shower. The shower shall not be able to be bypassed.

F. Shower water shall be drained, collected and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as RACM asbestos waste.

G. The equipment room shall be used for the storage of tools and equipment. A walk-off pan filled with water shall be located in the Work Area outside the equipment room for Workers to clean foot coverings when leaving the Work Area. A labeled 6 mil plastic ACM waste bag for collection of contaminated clothing shall be located in this room.

H. The personal decontamination enclosure shall be cleaned and disinfected minimally at the end of each Work shift and as otherwise directed by the Abatement Project Monitor.

3.03 WASTE DECONTAMINATION ENCLOSURE

A. Provide a waste decontamination enclosure contiguous to the Work area or as per Variance. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed and sheathed to prevent unauthorized entry.

B. The waste decontamination enclosure system shall consist of a holding area, airlock and washroom. The airlock shall be a minimum of three (3) feet from door to door. The entrance to the holding area shall have a lockable door.

C. The decontamination enclosure ceiling and walls shall be covered with one (1) layer of opaque 6 mil fire retardant polyethylene sheeting on walls and ceiling. Two (2) layers of reinforced 6 mil fire retardant polyethylene sheeting shall be used to cover the floor.

D. Where there is only one egress from the Work Area, the holding area of the waste decontamination enclosure system may branch off from the personal decontamination enclosure equipment room, which then serves as the waste wash room.

E. The waste wash room water shall be drained, collected, and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as RACM asbestos waste.

F. In small asbestos Projects where only one (1) egress from the Work Area exists, the shower room may be used as a waste washroom. In this instance, the clean room shall not be used for waste storage, but shall be used for waste transfer to carts, which shall immediately be removed from this enclosure.

3.04 WORK AREA ENTRY AND EXIT PROCEDURES

A. Access to and from the asbestos Work Area is permitted only through the personal decontamination enclosure unless otherwise stipulated in a Variance.

B. Workers shall sign the Work Area entry/exit log (located in the decontamination clean room) upon every entry and exit.

C. The following procedures shall be followed when entering the Work Area:
   1. Before entering the Work Area, Workers shall proceed to the clean room, remove all street clothes, and don protective clothing, equipment, and respirators.
   2. Workers shall proceed from the clean room through the shower room and the equipment room and into the Work Area.

D. The following procedures shall be followed when exiting the Work Area:
   1. Before leaving the Work Area, gross asbestos contamination will be removed by brushing, wet cleaning and/or HEPA vacuuming.
   2. In the equipment room, Workers shall remove disposable clothing, but not respirators, and shall place clothing in plastic disposal bags for disposal as contaminated debris prior to entering the shower room.
   3. Workers shall shower thoroughly while wearing respirators then wash respirator with soap and water prior to removal.
   4. Upon exiting the shower, Workers shall don new disposable clothing if the Work shift is to continue or street clothes to exit area. Under no circumstances shall Workers enter public non-Work Areas in disposable protective clothing.

E. If remote decontamination enclosures are permitted by applicable regulations or a Variance, workers shall wear two disposable suits for all phases of Work. Workers exiting the work area shall HEPA vacuum the outer suit, enter the airlock, remove the outer suit and then place it back into the Work Area. A clean second suit shall be donned before exiting the airlock and proceeding to the decontamination enclosure or another work area via the designated pathway.

3.05 WORK AREA PREPARATION

A. Asbestos danger signs shall be posted at all approaches to the asbestos Work Area. Post all emergency exits as emergency exits only on the Work Area side; post with asbestos caution signs on the non-Work Area side. Provide all non-Work Area stairs and corridors accessible to the asbestos Work Area with warning tapes at the base of stairs and beginning of corridors. Warning tapes shall be in addition to caution signs.

B. Shut down and lock out the building heating, ventilating, and air conditioning (HVAC) systems. Electrical systems and circuits shall also be shut down unless permitted to remain active per applicable regulations and appropriately protected and labeled. Existing lighting sources shall not be utilized. Provide temporary electric power and lighting as specified herein.

C. All non-ACM surfaces and objects within the Work Area shall be pre-cleaned using HEPA vacuuming and/or wet-wiping methods. Dry sweeping and any other methods that raise dust shall be prohibited. ACM shall not be disturbed during pre-cleaning.

D. Movable objects within the Work Area shall be HEPA vacuumed and/or wet-wiped and removed from the Work Area.

E. All non-movable equipment in the Work Area shall be completely covered with two (2) layers of fire retardant polyethylene sheeting, at least 6 mil in thickness, and secured in place with duct tape and/or spray adhesive. Active Fire Protection System components in the Work Area shall not be covered with fire retardant plastic sheeting or any other obstruction.

F. Provide enclosure of the asbestos Work Area necessary to isolate it from unsealed areas of the building in accordance with the approved asbestos Work plan and as specified herein.

G. Provide critical barriers by sealing off all openings including but not limited to windows, diffusers, grills, electrical outlets and boxes, doors, floor drains, and any other penetrations of the Work Area enclosure, using two (2) layers of at least 6 mil fire retardant polyethylene sheeting.

H. Provide isolation barriers by installing temporary framing and sheathing at openings larger than 32 square feet forming the limits of the asbestos Work Area. Sheathing thickness must be a minimum of 3/8 inch and all sheathing shall be caulked and the Work Area side sealed with two (2) layers of 6 mil fire retardant polyethylene sheeting.

I. Isolation barriers shall be installed at all elevator openings in the Work Area. Elevators running through the regulated abatement work area shall be shut down or isolated as per applicable regulations. Elevator controls shall be modified so that elevators bypass the Work Area.

J. Provide two (2) independent layers of 6 mil fire retardant polyethylene sheeting over all floor, wall, and ceiling surfaces. Each sheet/layer shall be individually applied and secured with tape, not folded over. Isolation barriers shall also be covered with two (2) independent layers (for a total of four (4) layers). Sheets shall be secured with duct tape. All joints in fire retardant polyethylene sheeting shall overlap 12" minimum. Carpeting left in place shall be covered with 3/8-inch plywood sheathing prior to plasticizing.

K. Unless otherwise specified for removal, the Contractor shall either protect all fiberglass insulation on piping, ductwork, tanks, etc. in the Work Area using two (2) layers of 6 mil fire retardant polyethylene or remove the insulation as asbestos-containing waste. If the Contractor elects to remove the fiberglass insulation, he/she shall be responsible for reinsulation, if piping is required to be insulated.

L. Frame out emergency exits. Provide double layer 6 mil fire retardant polyethylene sheeting and tape seal opening. Post as emergency exits only and mark with photoluminescent paint or signage. Provide a cutting tool on the Work Area side of exit.

M. Remove all items attached to or in contact with ACM only after the Work Area enclosure is in place. HEPA vacuum and wet wipe with amended water all removed items prior to their removal from the Work Area and before the start of asbestos removal operations.

N. Suspended ceiling tiles shall only be removed after Work Area preparation is complete. If possible, non-contaminated ceiling tiles shall be HEPA vacuumed and removed from the Work Area before asbestos removals begin. Contaminated ceiling tiles and porous ceiling tiles in work areas with ACM debris located above the ceiling shall be disposed of as RACM asbestos waste.

3.06 NEGATIVE AIR PRESSURE FILTRATION SYSTEM

A. Provide a portable asbestos filtration system that develops a minimum pressure differential of negative 0.02 inches of water column within all full enclosure areas relative to adjacent unsealed areas and that provides a minimum of four (4) air changes per hour in the Work Area during abatement and six (6) air changes for non-friable flooring and/or mastic removal.

B. Such filtration systems must be made operational after critical and isolation barriers are installed but before wall, floor, and ceilings are plasticized and shall be operated 24 hours per day during the entire Project until the final cleanup is completed and satisfactory results of the final air samples are received from the laboratory.

C. The system shall include a series of pre-filters and filters to provide High Efficiency Particulate Air (HEPA) filtration of particles down to 0.3 microns at 100% efficiency and below 0.3 microns at 99.9% efficiency. Provide sufficient replacement filters to replace pre-filters every 2 hours, secondary pre-filters every 24 hours, and primary HEPA filters every 600 hours of operation. HEPA filter sides shall be marked with the date of installation during all new HEPA filter installations on the Project.

D. A minimum of one (1) additional filtration unit of at least the same capacity as the primary unit(s) shall be installed and fully functional to be used during primary unit (s) filter changing and in case of primary failure.

E. If the containment area includes either the entire floor of the building or an area greater than 15,000 square feet on any floor, install a negative air cut off switch, similar to NYC DEP regulatory requirements.

F. Upon electric power failure or shut-down of any filtration unit, all abatement activities shall stop immediately and only resume after power is restored and all filtration units are fully operating. For shut-downs longer than one-half hour, all openings into the Work Area, including the decontamination enclosures, shall be sealed.

G. The Contractor shall provide a manometer to verify negative air pressure. Manometers shall be read twice daily and recorded within the Supervisor's Daily Project Log.

H. There shall be at least a four (4) hour settling period after the Work Area is fully prepared, small and large projects only, as defined by 12 NYCRR Part 56, and the negative filtration units have been started to ensure integrity of the barriers.

I. Once installed and operational, the Contractor's Supervisor shall conduct daily inspections of the Work Area to ensure the airtight integrity of the enclosure and operation of the negative air system. Findings shall be recorded within the Daily Project Log. Inspections shall also be conducted on days when no abatement activities are in progress.

3.07 REMOVAL OF ASBESTOS-CONTAINING MATERIALS

A. If new (previously unidentified) suspect ACM is discovered during the course of a Project, the Owner or Owner's Representative shall be notified. The Contractor is prohibited from collecting bulk samples.

The Designer of Record shall have bulk samples collected by a dually certified NYS DOL asbestos inspector to determine asbestos content.

B. Definition of Substrate – The underlying support, foundation or base (e.g. wood lathe, wire screen, concrete, etc.) to which a single layer or multilayered system (e.g. plaster, roofing, etc.) is applied.

C. Asbestos-containing materials shall be removed in accordance with the Contract Documents and the approved Asbestos Work Plan. Only one (1) type of ACM shall be abated at a time within a Work Area. Where there are multiple types of ACM requiring abatement, applicable regulations procedures for sequential abatement shall be followed.

D. Sufficiently wet asbestos materials with a low pressure, airless fine spray of surfactant to ensure full penetration to substrate prior to material removal. Re-wet material that does not display evidence of saturation.

E. One (1) Worker shall continuously apply amended water while ACM is being removed. All layers of ACM shall be removed to the underlying substrate (e.g. concrete, roof deck, piping, etc.), unless stated otherwise in the contract documents.

F. Perform cutting, drilling, abrading, or any penetration or disturbance of asbestos-containing material in a manner to minimize the dispersal of asbestos fibers into the air and may require a NYS DOL site specific variance. Use equipment and methods specifically designed to limit generation of airborne asbestos particles. All power operated tools used shall be provided with manufacturer equipped HEPA filtered local exhaust ventilation.

G. Upon removal of ACM from the substrate, the newly exposed surfaces shall be HEPA vacuumed and/or wet cleaned. Surfaces must be thoroughly cleaned using necessary methods and any required solvents to completely remove any adhesive, mastic, etc.

H. All removed material shall be placed into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate. ACM is not permitted to lie on the floor for any period of time. Cleanup of accumulations of loose debris or waste shall be performed whenever there is enough accumulation to fill a single bag or container and minimally at the end of each work shift.

I. Large components shall be wrapped in two (2) layers of 6 mil polyethylene sheeting. Sharp components likely to tear disposal bags shall be placed in fiber drums or boxes and then wrapped with sheeting.

J. Power or pressure washers are not permitted for asbestos removal. Power or pressure washers are allowed during clean-up procedures only if stated in an approved Site-Specific Variance and allowed by the Owner.

K. All open ends of pipe and duct insulation not scheduled for removal shall be encapsulated using lag cloth.

L. All construction and demolition debris determined by the Environmental Consultant to be contaminated with asbestos shall be handled and disposed of as RACM asbestos waste.

M. The use of metal shovels, metal dust pans, etc. are not permitted inside the work area.

3.08 EQUIPMENT AND WASTE CONTAINER DECONTAMINATION AND REMOVAL PROCEDURES

A. External surfaces of contaminated containers and equipment shall be cleaned by wet cleaning and/or HEPA vacuuming in the Work Area before moving such items into the waste decontamination enclosure system airlock by persons assigned to this duty. The persons in the Work Area shall not enter the airlock. No gross removal operations are permitted when waste transfer is in progress.

B. The containers and equipment shall be removed from the airlock by persons stationed in the washroom during waste removal operations. The external surfaces of containers and equipment shall be cleaned a second time by wet cleaning.

C. The cleaned containers of asbestos material and equipment are to be dried of any excessive pooled or beaded liquid, placed in uncontaminated 6 mil plastic bags or sheeting, as the item's physical characteristics demand, and sealed airtight.

D. The clean recontainerized items shall be moved into the airlock that leads to the holding area. Workers in the washroom shall not enter this airlock.

E. Containers and equipment shall be moved from the airlock and into the holding area by persons dressed in clean personal protective equipment, who have entered from the holding area.

F. The cleaned containers of asbestos material and equipment shall be placed in water tight carts with doors or tops that shall be closed and secured. These carts shall be held in the holding area until transfer to the waste trailer/container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

G. The exit from the decontamination enclosure system shall be secured to prevent unauthorized entry.

H. Where the waste removal enclosure is part of the personal decontamination enclosure, waste removal shall not occur during shift changes or when otherwise occupied. Precautions shall be taken to prevent short circuiting and cycling of air outward through the shower and clean room.

3.09 WORK AREA DECONTAMINATION, CLEANING, AND CLEARANCE PROCEDURES

A. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed unless modified by a Variance.

B. First Cleaning:
   1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
   2. All surfaces in the Work Area shall be wet cleaned, except active fire protection system components that may be damaged by water. A wet-purpose shop vacuum may be used to pick up excess liquid, and may either be decontaminated prior to removal from the Work Area or disposed of as RACM asbestos waste.
   3. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement and document the results in the project log accordingly.
   4. The Contractor shall then apply a thin coat of encapsulant to all surfaces in the Work Area that were not the subject of removal. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be

pigmented or tinted to provide an indication for completeness of coverage. The Abatement Project Monitor shall determine adequacy of coverage.

5. After the encapsulant has been applied and the required waiting/settling and drying time has elapsed, the first layer of fire retardant polyethylene sheeting shall then be removed and bagged as RACM asbestos waste.

C. Second Cleaning

1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. The Abatement Project Monitor shall conduct a second visual inspection of the Work Area for cleanliness and document the results in the project log accordingly.
3. After the required waiting/settling and drying time has elapsed, the second layer of fire retardant polyethylene sheeting shall be removed and bagged as RACM asbestos waste.

D. Third Cleaning

1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. After the required waiting/settling and drying time has elapsed, the Abatement Project Monitor shall conduct a third visual inspection of the Work Area for cleanliness and document the results in the project log accordingly.
3. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the APM provided no visible asbestos debris/residue; pools of liquid, or condensation remains. NOTE: TEM samples should be used vs. PCM if demolition or other dust-generating evolutions are taking place in adjacent areas, as evident from excessive loading.
4. Upon receipt of satisfactory final clearance air sampling results, the negative air pressure equipment can be shut down and the isolation and critical barriers removed and bagged as RACM asbestos waste.

E. After isolation and critical barriers are removed, the Abatement Project Monitor and Contractor's Supervisor shall inspect the Work Area for cleanliness. If necessary, additional cleaning shall be performed by the Contractor as directed by the Abatement Project Monitor. Following the satisfactory inspections, the decontamination enclosures shall be removed.

F. As a result of any visual inspection by the Abatement Project Monitor or should air sampling results indicate high fiber levels, the Contractor will clean or reclean the affected areas at no additional expense to the Owner. Clearance air samples shall be collected again if previous results failed, at no additional expense to the Owner. The Contractor shall be back-charged for the additional clearance air sample collection and analysis.

3.10 TENT ENCLOSURES

A. Tent enclosures may only be used where specifically permitted by applicable regulations or a Variance.

B. The Contractor shall restrict access to the immediate area where tent removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

C. Personal and waste decontamination enclosures shall be constructed. Configuration shall be as required by Project size. Remote personal decontamination enclosure may be allowed by variance.

D. The Work Area shall be precleaned. All objects and equipment that will remain in the restricted area during abatement shall be sealed with two (2) layers of six mil fire retardant polyethylene and tape.

E. The tent shall be a single use barrier constructed with a rigid frame and at least two (2) layers of 6 mil fire retardant polyethylene unless one (1) layer of 6 mil fire retardant polyethylene is otherwise permitted by applicable regulations. All seams shall be sealed airtight using duct tape and/or spray adhesive.

F. The tent shall be constructed with at least one (1) airlock for worker/waste egress.

G. A monometer shall be used for all enclosures.

H. Negative air shall be maintained at four (4) air changes per hour for non-friable and glovebag abatement tent enclosure work areas. Eight (8) air changes shall be maintained for friable gross removal tent enclosure work areas.

I. OSHA compliance air monitoring is required per section 1.09.

J. ACM removal shall follow procedures defined in section 3.07.

K. Waste material shall be placed in properly labeled 6 mil plastic bags or other appropriate containers. The outside of the bags or containers shall be wet wiped and/or HEPA vacuumed in the wash room and shall then be placed in a second bag/container before being transferred to the waste storage container. All transportation of waste bags and containers outside the Work Area shall be in watertight carts. These carts shall be held in the holding area until transfer to the waste storage container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

L. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed.
   1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
   2. All surfaces in the Work Area shall be wet cleaned. A wet-purpose shop vacuum may be used to pick up excess liquid, and shall be decontaminated prior to removal from the Work Area.
   3. The asbestos supervisor shall perform a visual inspection of the work area(s) followed by the APM prior to applying the encapsulation.
   4. The Contractor shall then apply a thin coat of encapsulant to all non-removal surfaces covered with plastic in the Work Area. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The APM shall determine adequacy of coverage.
   5. After the waiting/settling/drying time requirements have elapsed, the Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement. The APM shall document the results of the visual inspection in the Project Monitor Log and Contractor's Daily Project Log.
   6. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the APM.
   7. Upon receipt of satisfactory final clearance air sampling results, the tent shall be collapsed into itself, placed in suitable disposal bags, and transported to the waste decontamination enclosure. Isolation and critical barriers shall then be removed and bagged as RACM asbestos waste followed by satisfactory visual inspections by the project supervisor and the APM for cleanliness.

3.11 GLOVEBAG REMOVAL

A. Glovebag removals may only be used as specifically permitted by applicable regulations or a Variance. Glovebags may only be used on piping.

B. In addition to conformance with applicable regulations and Variances, glovebag removals are only permitted to be conducted within full containments or tent enclosures complying with these specifications.

C. The Contractor shall restrict access to the immediate area where tent/glovebag removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

D. Personal and waste decontamination enclosures shall be constructed. Configuration shall be as required by Project size. Remote personal decontamination enclosure may be allowed by variance.

E. Glovebag removals shall utilize commercially available glovebags of at least 6 mil thickness. Use shall be in accordance with the manufacturer's instructions and the following minimum requirements:
   1. The sides of the glovebag shall be cut to fit the size pipe being removed. Tools shall be inserted into the attached tool pocket.
   2. The glovebag shall be placed around the pipe and the open edges shall be folded and sealed with staples and duct tape. The glovebag shall also be sealed at the pipe to form a tight seal.
   3. Openings shall be made in the glovebag for the wetting tube and HEPA vacuum hose. The opening shall be sealed to form a tight seal.
   4. All glovebags shall be smoke tested by the Abatement Project Monitor under negative pressure using the HEPA vacuum before removal operations commence. Glovebags that do not pass the smoke test shall be resealed and then retested.
   5. After first wetting the materials to be removed, removal may commence. ACM shall be continuously wetted. After removal of the ACM, the piping shall be scrubbed or brushed so that no visible ACM remains. Open ends of pipe insulation shall be encapsulated.
   6. After the piping is cleaned, the inside of the glovebag shall be washed down and the wetting tube removed. Using the HEPA vacuum, the glovebag shall be collapsed and then twisted and sealed with tape with the ACM at the bottom of the bag.
   7. A disposal bag shall be placed around the glovebag that is then detached from the pipe. The disposal bag is then sealed and transferred through the wash room to the waste storage container.

F. After glovebag removals are complete, containment/tent decontamination procedures shall be followed.

3.12 REMOVALS OF EXTERIOR NON-FRIABLE ACM

A. Except as modified by this section, removal of exterior non-friable ACM shall conform to all provisions of this specification.

B. Unless Variances have been otherwise obtained, removals shall be conducted in accordance with the provisions of applicable regulations.

C. The Work Area shall be the area from which ACM materials are being removed and shall extend 25 feet from the perimeter of the removal area.

D. Non-certified Workers are not allowed in the Work Area until the Work Area is cleared by the Abatement Project Monitor.

E. Personal and waste decontamination enclosures shall be constructed at a location in accordance with the approved Work Plan and applicable regulations. Unless located outside the Work Area, decontamination enclosures are not permitted to be constructed on the roof. Remote personal decontamination enclosure may be allowed by variance.

F. All openings (including but not limited to operable windows, doors, hatches, vents, ducts, and grilles) one (1) story above, one (1) story below, and within 25 feet of the work area shall be sealed with two (2) layers of 6 mil fire retardant polyethylene.

G. The removal of the ACM may require the use of scrapers, solvents, mastic removal chemicals, or other methods/procedures to ensure complete removal. Use of mechanical equipment without a tent containment, including, but not limited to chipping gun/hammer is prohibited without an approved NYS DOL site specific variance. Refer to Section 2.10 for other Power tool requirements.

H. The Contractor is required to provide temporary protection of the building (i.e. roof, window openings, construction joints, etc.) at the end of each Work shift so as to maintain the building in a watertight condition.

I. All asbestos waste generated shall be containerized in the work area, prior to transfer to waste storage trailer/container/dumpster. No waste shall remain in the work area at the end of each work shift. All waste shall be disposed of as RACM asbestos waste including projects where waste transfer procedures are modified by Site Specific Variance.

J. Waste Containers used for waste storage shall be lined with two (2) layers of six mil polyethylene and shall have a hard top (fully enclosed). Canvas cover or open topped dumpsters shall not be used to store asbestos waste unless permitted by a Site-Specific Variance.

K. Personal protective equipment, including respirators, shall be utilized and worn during all removal operations until the Work Area is cleared by the Abatement Project Monitor.

L. If air samples collected during abatement indicate any airborne asbestos fiber concentration(s) at or above 0.01 f/cc or the background level, whichever is greater, Work shall be stopped immediately and Work methods shall be altered to reduce the airborne asbestos fiber concentration(s).

M. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed:
   1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned.
   2. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completeness of abatement, prior to conducting final air clearance.
   3. Upon obtaining satisfactory clearance air sample results, the isolation and critical barriers shall be removed and bagged as RACM asbestos waste. Following this, the decontamination enclosures shall be removed.

3.13 NON-FRIABLE FLOORING AND/OR MASTIC REMOVALS

A. The following procedures may only be used for the removal of non-friable flooring and/or mastic materials using manual and chemical methods. These procedures shall not apply to beadblaster use or other abrasive abatement methods.

B. The Contractor shall restrict access to the immediate area where removals are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

C. Personal and waste decontamination enclosures shall be utilized and shall be constructed at a location in accordance with the approved Work Plan. Remote personal decontamination enclosure may be allowed by variance.

D. The Work Area shall be prepared per applicable regulations.

E. Negative air shall be maintained at six (6) air changes per hour.

F. OSHA compliance air monitoring is required per section 1.09.

G. ACM removal shall follow procedures defined in section 3.07.

H. Waste material shall be placed in properly labeled 6 mil plastic bags or other appropriate containers. The outside of the bags or containers shall be wet wiped and/or HEPA vacuumed before being passed into the wash room for double- bagging. The bags or containers shall then be transferred to the waste storage container. All transfer of waste bags and containers outside the Work Area shall be in watertight carts.

I. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed.
   1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
   2. All surfaces in the Work Area shall be wet cleaned. A wet-purpose shop vacuum may be used to pick up excess liquid, and shall be decontaminated prior to removal from the Work Area.
   3. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement.
   4. The Contractor shall then apply a thin coat of encapsulant to all non-removal surfaces covered with plastic in the Work Area. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The Abatement Project Monitor shall determine adequacy of coverage.
   5. After the encapsulant has been applied and the required waiting/settling and drying time has elapsed, aggressive final clearance air sampling shall then be conducted by the Environmental Consultant.
   6. Upon receipt of satisfactory final clearance air sampling results, the isolation and critical barriers shall be removed. Following this, the decontamination enclosures shall be removed.

3.14 RESTORATION OF UTILITIES, FIRESTOPPING, AND FINISHES

A. After final clearance, remove locks and restore electrical and HVAC systems. All temporary power shall be disconnected, power lockouts removed and power restored. All temporary plumbing shall be removed.

B. Finishes damaged by asbestos abatement activities including, but not limited to, plaster/paint damage due to duct tape and spray adhesives, and floor tile lifted due to wet or humid conditions, shall be restored prior to final payment.
   1. Finishes unable to be restored shall be replaced under this Contract.
   2. All foam and expandable foam products and materials used to seal Work Area openings shall be completely removed upon completion of abatement activities.

C. All penetrations (including, but not limited to, pipes, ducts, etc.) through fire rated construction shall be firestopped using materials and systems tested in accordance with ASTM E814 on Projects where reinsulation is part of the required work.

PART 4 DISPOSAL OF ASBESTOS WASTE

4.01 TRANSPORTATION AND DISPOSAL SITE

A. The Contractor's Hauler and Disposal Site shall be approved by the Owner. All waste generated during the asbestos project shall be disposed of as RACM asbestos waste.

B. The Contractor shall give 24 hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. No waste may be taken from the site unless the Contractor and APM are present and the APM authorizes the release of the waste as described herein.

C. All waste generated as part of the asbestos project shall be removed from the site within ten (10) calendar days after successful completion of all asbestos abatement work.

D. Upon arrival at the Project Site, the Hauler must possess and present to the APM a valid US DOT Hazardous Waste Transporter Permit, New York State Department of Environmental Conservation Part 364 Asbestos Hauler's Permit required permit/license. The APM may verify the authenticity of the hauler's permit with the proper authority.

E. The Hauler, with the Contractor and the APM, shall inspect all material in the transport container prior to taking possession and signing the Asbestos Waste Shipment Records.

F. Unless specifically approved by the Owner, the Contractor shall not permit any off-site transfers of the waste or allow the waste to be transported or combined with any other off-site asbestos material. The Hauler must travel directly to the disposal site as identified on the notifications with no unauthorized stops.

G. The APM shall verify the landfill to be used for waste disposal with the waste transporter (driver) and Contractor prior to the waste trailer/dumpster leaving the site. The APM shall confirm the waste transporter firm and landfill are listed on the regulatory notifications for the project and the waste transport vehicle license number is listed on the current NYS DEC Waste Transporter permit.

4.02 WASTE STORAGE CONTAINERS

A. All waste containers shall be fully enclosed with a hard top and be lockable (i.e. enclosed dumpster, trailer, etc.). No open containers will be permitted on-site (i.e. open dumpster with canvas cover, etc.) unless specifically permitted by a Variance. When asbestos contaminated waste must be kept on the work

site overnight or longer, it shall be double bagged and stored in accordance with Federal, State, and local laws.

B. The APM shall verify that the waste storage container and/or truck tags (license plates) match the information listed on the New York State Department of Environmental Conservation Part 364 permit. Any container not listed on the permit shall be removed from the site immediately.

C. The container shall be plasticized and sealed with two (2) layers of 6 mil polyethylene. Once on site, it shall be kept locked at all times, except during load out. The waste container shall not be used for storage of equipment or contractor supplies.

D. While on-site, the container shall be labeled with EPA Danger signage:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

E. The New York State Department of Environmental Conservation Asbestos Hauler's Permit number shall be stenciled on both sides and back of the container.

F. The container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed, and has the permit number appropriately stenciled on the container.

G. Waste generated off-site is not permitted to be brought onto the Project site and loaded into the waste container.

H. All asbestos waste removed from the Project site shall be transported directly to the disposal site without any additional waste being added to the container during transport.

I. The Owner may initiate random checks at the Disposal Site to ensure that the procedures outlined herein are complied with.

4.03 HAULER'S ASBESTOS WASTE SHIPMENT RECORDS

A. The Hauler's Waste Shipment Record shall be completed by the Contractor and verified by the APM that all the information and amounts are accurate and the proper signatures are in place.

B. The Waste Shipment Records shall have the appropriate signatures of the APM, the Contractor, and the Hauler representatives prior to any waste being removed from the site.

C. Copies of the completed Hauler's Waste Shipment Record shall be retained by the APM and the Contractor and shall remain on site for inspection.

D Upon arrival at the Disposal Site, the Hauler's Waste Shipment Record shall be signed by the Disposal Facility operator to certify receipt of ACM covered by the Waste Shipment Record.

E. The Disposal Facility operator shall return the original Hauler's Waste Shipment Record to the Contractor.

F. The Contractor shall forward copies of the Hauler's Waste Shipment Record to the APM within 14 days of the waste container being removed from the site. Failure to do so may result in payment being withheld from the Contractor.

G. Originals of all Waste Shipment Records and Waste Shipment Record Logs shall be submitted by the Contractor to the Owner with the final close-out documentation.

END OF SECTION 02 82 0

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SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. The scope for this Section includes but is not limited to the following as shown on the drawings and as specified herein:

1. Foundation systems including footings, mats, grade beams, piers, pilasters, pits, foundation walls and similar concrete.
2. Slabs on grade.
3. Structural slabs on metal deck
4. Concrete equipment pads

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Project site at least 30 days prior to the start of the concrete construction schedule.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips,

semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Samples: Submit samples of materials as requested by the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data for the installer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

I. As-built survey of the concrete foundation wall footings, foundation walls, piers, anchor bolts and general layout.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Weldable Low-Alloy-Steel Reinforcing Bars: ASTM A706, Grade 60, deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A775, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

D. Steel Wire and Welded Wire Reinforcement: ASTM A1064. Galvanized at exterior locations, conditions permanently exposed to weather and/or water, and where noted on drawings.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, ASTM A775 epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775.

D. Zinc Repair Material: ASTM A780.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I, II, or I/II.
2. Fly Ash: ASTM C618, Class F or C.
3. Slag Cement: ASTM C989, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595.
5. Silica Fume: ASTM C1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal for footings, 1 inch nominal for foundation walls, piers, grade beams, tie beams and above grade columns and beams and 3/4 inch nominal for slabs.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330, 3/4-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260.

1. Liquid air entrainment: Subject to compliance with requirements, provide one of the following or equal approved by Engineer or Record:
   a. "Air Mix" — Euclid Chemical Co.
   b. "AEA-92" — Euclid Chemical Co.
   c. "Darex AEA" — W. R. Grace.
   d. "MasterAir VR 10" — Master Builders.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
   a. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer or Record:
      i. "MasterPolyheed 997" — Mater Builders.
      ii. "Euclid MR" — Euclid Chemical Co.
      iii. "WRDA 64" — W. R. Grace.

2. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
   a. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:
      i. "Eucon Retarder 75" — Euclid Chemical Co.
      ii. "Pozzolith 100XR" — Master Builders.
      iii. "Plastiment" — Sika Chemical Co.
      iv. "Daratard" — W. R. Grace.

3. High-Range, Water-Reducing Admixture: ASTM C494, Type F or Type G.
   a. Products: Subject to compliance with requirements, provide one of following or equal approved by Engineer of Record:
      i. "Eucon 37, 1037 or Plastol 5000" — Euclid Chemical Co.
      ii. "Rheobuild 1000" — Master Builders.
      iii. "MasterGlenium 7500" — Master Builders.
      iv. "Daracem-100" — W. R. Grace.

4. Plasticizing and Retarding Admixture: Provide product complying with ASTM C1017, Type II and subject to approval by Engineer of Record.

5. Crystalline Waterproofing: Provide product complying with NSF/ANSI Standard 61 and applied as a coating over concrete surfaces to reduce water permeability.

   a. Acceptable Manufacturers:
      1) Kryton International Inc.
      2) Euclid Chemical Co.
      3) Xypex Chemical Corporation

G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.

1. Products: Subject to compliance with requirements, provide the following or equal approved by Engineer of Record:
   a. "Accelguard 80" — Euclid Chemical Co.

b.	"Daraset"	W. R. Grace.
c.	"Pozzutec 20"	Master Builders.

H. Water: ASTM C94.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufactures: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:
   a. Greenstreak
   b. Williams Products, Inc
2. Profile: As indicated.
3. Dimensions: As indicated.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufactures: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:
   a. BoMetals, Inc.
   b. Greenstreak
   c. Paul Murphy Plastics Company
   d. Vinylex Corp.
2. Profile: As indicated.
3. Dimensions: As indicated.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufactures: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"MiraSTOP"	Carlisle Coatings & Waterproofing, Inc
b.	"Waterstop-RX"	CETCO
c.	"Conseal CS-231"	Concrete Sealants Inc.
d.	"Swellstop"	Greenstreak
e.	"Hydro-Flex"	Henry Company, Sealants Division
f.	"Earth Shield Type 20"	JP Specialties, Inc.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A or B. The membrane shall have a water-vapor permeance rate no greater than 0.012 perms when tested in accordance with ASTM E 154, Section 7. The vapor barrier shall be placed over prepared base material where indicated below slabs on grade. Vapor barrier shall be no less than 10 mil thick in accordance with ACI 302.1R. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:
   a. "Stego Wrap (10 mil) Vapor Barrier" Stego Industries LLC.
   b. "Griffolyn Vaporguard" Reef Industries.
   c. "Premoulded Membrane with Plastmatic Core" W. R. Meadows.

2.8 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

C. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.

D. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

2.9 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Eucobar by Euclid Chemical Co.

2. MasterKure ER 50 by BASF

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Everclear VOX by Euclid Chemical Co.

2. VOCOMP-25 by W.R. Meadows

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D175, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D2240.

C. Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 and ACI 318.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

2. Submit each proposed mix to the Architect and Structural Engineer for review at least 5 days prior to the concrete preinstallation conference.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
5. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup and the contract drawings.

2.14 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, foundation walls and concrete piers.

1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.40.
4. Slump Limit:
   a. 4 inches, plus or minus 1 inch

b. 8 inches, plus or minus 1 inch for concrete with verified slump of 4 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

5. Slump Flow Limit: Per ASTM C1611, as permitted under ACI 301.
6. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch or 3/4-inch nominal maximum aggregate size. 5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-1/2-inch nominal maximum aggregate size

B. Class A: Normal-weight concrete used exterior slab-on-grade, including Sallyport.

1. Exposure Class: ACI 318 F3.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.40.
4. Slump Limit:
   a. 4 inches, plus or minus 1 inch
   b. 8 inches, plus or minus 1 inch for concrete with verified slump of 4 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Slump Flow Limit: Per ASTM C1611, as permitted under ACI 301.
6. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch or 3/4-inch nominal maximum aggregate size. 5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-1/2-inch nominal maximum aggregate size

C. Class A: Normal-weight concrete used for interior slab-on-grade and composite metal deck slab.

1. Exposure Class: ACI 318 F1.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.55.
4. Slump Limit:
   a. 4 inches, plus or minus 1 inch
   b. 8 inches, plus or minus 1 inch for concrete with verified slump of 4 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Slump Flow Limit: Per ASTM C1611, as permitted under ACI 301.
6. Air Content:
   a. Exposure Classes F1: 5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size. 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size

D. Class A: Normal-weight concrete used for interior mechanical pads.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.55.
4. Slump Limit:
   a. 4 inches, plus or minus 1 inch

b. 8 inches, plus or minus 1 inch for concrete with verified slump of 4 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

5. Slump Flow Limit: Per ASTM C1611, as permitted under ACI 301.
6. Air Content:
   a. Exposure Classes F1: 5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size. 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50

deg F for 24 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A780. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time

necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view, to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15; for suspended slabs.
    b. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24; for slabs on grade.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

G. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

E. Grout base plates and foundations as indicated using specified free-flowing non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial

application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Follow manufacturer’s written instructions regarding cure time before applying to the concrete surface.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks more than 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

G. All concrete repairs shall be performed to the Architect’s satisfaction at the sole expense of the Contractor.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.

2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231, pressure method, for normal-weight concrete; ASTM C173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31.

   a. Cast and field cure five (5) 6" x 12" standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39;

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days. Test one field-cured specimen at 56 days if requested by the Architect.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, temperature, placement time or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 034900 - GLASS-FIBER-REINFORCED CONCRETE

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the glass fiber reinforced concrete (GFRC) fabrications as indicated on drawings and specified herein. Work of this section includes, but is not limited to, the following:

1. Exterior panels and decorative elements.

2. Attachment hardware and accessories.

3. Aluminum attachment system to CMU and steel stud framing.

1.3 RELATED SECTIONS

A. Unit masonry – Section 042000.

B. Cold formed metal framing – Section 054000.

C. Sheet Metal Flashing - Section 076200.

D. Joint Sealants - Section 079200.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer of glass fiber reinforced cement panels shall be a firm that successfully fabricated GFRC components specified for a period of not less than five (5) years and is equipped to provide the quality and quantity shown. Manufacturing plant shall be certified by the Prestressed Concrete Institute.

B. Mock-Up: As shown in A Drawings.

1.5 GLASS FIBER REINFORCED CONCRETE PERFORMANCE CRITERIA

A. GFRC components and assemblies shall comply with the Codes and regulations of all Governing Agencies having jurisdiction. When applicable Codes or specified requirements differ, the more stringent conditions shall be provided. Except when applicable codes make other provisions, or as otherwise noted herein, the loads shall act in combinations that provide the most unfavorable conditions.

B. Wind Loads: The wind loads on the GFRC components and its connections shall be positive and negative per local Building Code.

1. Design Wind Pressure shall be multiplied by a Load Factor of 1.50. With this Load Factor applied, design stresses shall not exceed yield point level or elastic buckling level,

whichever is lower. No wall element, including sealants and sealed joints, shall sustain permanent deformation or failure under loading equivalent to 1.5 times the Design Wind Pressures.

2. Stresses shall not exceed the allowable values established and recommended by Prestressed Concrete Institute. In no case shall allowable values exceed the yield stress. For load combinations, a reduction in load or increase in allowable stress (but not both) may be used only if permitted by code.

1.6 SUBMITTALS

A. Product Data: Submit specifications and other data for each type of GFRC required, including certification that type complies with specified requirements. Include instructions for handling, storage, installation, protection, and cleaning.

B. Samples: Submit sets of samples of each different color, grade and finish. Include in each set full range of exposed color and texture to be expected in completed work, 16 by 16 inches and of actual thickness.

C. Shop Drawings: Submit cutting and setting drawings showing sizes, dimensions, sections and profiles of GFRC units, arrangement and provision for jointing, anchoring, and fastening, supports and other necessary details for lifting devices and reception of other work, including the following:

1. Unit shapes (elevations and sections) and dimensions.

2. Thickness of facing and GFRC backing.

3. Finishes.

4. Steel stud frame details.

5. Joint and connection details.

6. Lifting and erection details.

7. Location and details of hardware attached to structure.

8. Size, location and details of flex and gravity anchors.

9. Handling procedures.

10. Sequence of erection for special conditions.

11. Relationship to adjacent material.

12. Description of all loose, cast-in, and field hardware.

D. The manufacturer shall not proceed with fabrication of any products prior to receiving approval of samples and erection drawings by the Architect.

E. Engineering Calculations: Submit engineering and design calculations to substantiate the anchoring methods and fastening devices and all GFRC indicated on the submitted shop drawings signed and sealed by a Professional Engineer licensed in the State of New York.

1. Calculations shall establish compliance with specified stress at all principal elements and the structural analysis of all connections. If calculations indicate any deficiencies, provide all items necessary to comply with the performance requirements without cost to the Owner.

2. Calculations shall be submitted on 8-1/2" x 11" sheets and shall be signed and sealed by a professional engineer registered in the State of New York.

3. The general design shown is presumed adequate to permit compliance with the specified performance. Provide details and calculations as necessary to verify and supplement the general design.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling

1. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses or damage.

2. Lift or support units only at the points shown on the erection shop drawings.

3. Place non-staining resilient spacers of even thickness between units.

4. Support units during shipment on non-staining shock-absorbing material.

5. Protect units from dirt and damage during handling and transport.

B. Storage at Job Site

1. Store units to protect them from contact with soiling, staining, and from physical damage.

2. Store units, unless otherwise specified, with non-staining, resilient supports located in same positions as when transported.

3. Store units on firm, level, and smooth surface.

4. Place stored units so that identification marks are easily readable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Plastrglas Architectural Fabrications.

2. David Kucera, Inc.

3. Stromberg Architectural Products.

4. DEC Architectural Composites.

5. Precast Stone NY Corp.

2.2 MATERIALS

A. Glass Fiber Reinforced Concrete

1. Portland Cement

a. ASTM C 150, Type I or III, with not more than 0.03% of water-soluble alkali. Color of cement shall be suitable to produce panel surface to match limestone used on building exterior cladding.
b. For surfaces exposed to view in the finished structure, use same brand, type, and source of supply throughout the GFRC production.

2. Aggregates

a. Sand shall conform to ASTM C 144, washed and dried silica or approved equal with history of successful use in GFRC. All sand shall pass through a No. 16 sieve.
b. Facing aggregate if used should conform to ASTM C 33 except for gradation. Aggregates shall be clean, hard, strong, durable, inert, and free of staining or deleterious material. Match exposed surface of panel to Architect sample.

3. Water: Free from deleterious matter that may interfere with the color, setting, or strength of the concrete.

4. Admixtures: Conforming to ASTM C 260, ASTM C 494, ASTM C 618 or acrylic thermoplastic copolymer dispersion conforming to PCI "Recommended Practice for Glass Fiber Reinforced Concrete Panels," Appendix F.

a. Accelerators, retarders, air-entraining agents and pozzolans may be used to achieve required characteristics. They should be used according to manufacturer's recommendations. Admixtures containing calcium chloride are not acceptable, unless recommended by manufacturer.

5. Coloring Agent: Conforming to ASTM C 979 shall be harmless to concrete set and strength, stable at high temperature and shall be sunlight fast and alkali resistant.

6. Glass Fiber: Conforming to PCI "Recommended Practice for Glass Fiber Reinforced Concrete Panels," Appendix E.

a. Fibers specifically designed to be compatible with the aggressive alkaline environment of Portland cement-based composites or fibers with a history of successful use in a Portland cement-based composite that has been modified to be compatible with the fiber.
b. Fabricator shall submit on request evidence that the glass composition, Portland cement matrix, or both have been designed for glass fiber reinforced concrete applications.

B. Attachment Hardware and Sprayed-In Anchors

1. Materials

a. Structural Steel: ASTM A 36.
b. Cold Drawn Wire: ASTM A 580, Type 304, Condition A.
c. Stainless Steel: ASTM A 666, Type 304, grade A or B.

d. Carbon Steel Plate: ASTM A 283, grade 60.
e. Malleable Iron Castings: ASTM A 47, grade 60.
f. Carbon Steel Castings: ASTM A 27, grade 60-30.
g. Anchor Bolts: ASTM A 325.

2. Finish

a. Hot-Dip Galvanized: ASTM A 153.

C. Reglets: Polyvinyl chloride extrusions or other approved non-metallic types, or approved metallic types as recommended by manufacturer.

D. Steel Framing System

1. Material

a. Galvanized studs and tracks shall be formed from steel conforming to ASTM A 570 or ASTM A 611 (Grades A, B, C or D).
b. Galvanized studs and tracks shall be formed from steel conforming to ASTM A 446.
c. Structural tubing shall be formed from steel conforming to ASTM A 500 Grade B.
d. Steel channels and angles shall be formed from steel conforming to ASTM A 36.

2. Finish

a. Rust inhibitive paint shall conform to FS-TT-P636C.
b. Galvanized coating shall conform to ASTM A 525 with a minimum G60 coating.

3. Studs shall have a minimum yield strength of 40 ksi and tracks shall have a minimum yield strength of 30 ksi.

E. Hand Spray Application

1. Spray operators shall be trained personnel.

2. Spray-up of the main body of material shall proceed before any facing mix has set.

3. Application shall be by spraying so that uniform thickness and distribution of glass fiber and cement matrix is achieved during the application process.

4. Consolidation shall be by rolling or other techniques as necessary to achieve complete encapsulation of fibers and compaction.

5. Control of thickness shall be achieved by using a pin gauge or other approved method. A minimum of one thickness checking shall be made per 5 sq. ft. of panel surface.

6. All hand-forming of intricate details, incorporation of formers of infill material, and over-spraying shall be carried out before the material has achieved its initial set so as to ensure complete bonding.

F. Insert and Embedments

1. Stainless steel inserts shall be properly embedded in built-up homogeneous GFRC bosses or bonding pads to develop their strength and prevent failure. Waste material such as overspray is not acceptable to encapsulate inserts or for bonding pads.

2. Rigid embedded items bonded to the GFRC shall not create undesirable restraint to volume changes.

G. Steel Stud Frame System to be engineered by Contractor

1. Steel stud frame shall be a prefabricated welded frame produced in accordance with the approved erection drawings.

2. All accessible welds shall be touched up after welding.

H. Allowable Tolerances: Manufacture units so that each panel complies with the dimensional tolerances listed below. For dimensional tolerances not listed below, those listed in PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," shall apply.

2.3 MIXES

A. GFRC Mix: Nominal glass content shall be not less than 5 percent and average yield and ultimate strengths shall not be less than 2500 psi.

B. Facing Mix: Thickness shall generally be the minimum possible to achieve the desired finish.

1. GFRC shall consist of Portland cement, water, glass fibers, sand, and may contain admixtures. The component materials shall be in accordance with Section 2.1.

C. Coloring Agent: The amount of coloring agent shall not exceed 10% of cement weight and should not have any detrimental effects on concrete qualities.

2.4 FABRICATION

A. Forms

1. Forms for GFRC panels shall be rigid and constructed of materials that will result in finished products conforming to the profiles, dimensions and tolerances indicated by the contract documents and on the approved shop drawings.

2. Release agents shall be applied and used according to manufacturer's instructions and shall be compatible with the architectural finish and joint sealants specified.

B. Proportioning and Mixing

1. All measured of mix constituents shall be carried out in a careful manner to achieve the desired mix proportions.

2. The glass fiber and cement slurry shall be metered to the spray head at rates to achieve the desired mix proportion and glass content. These shall be checked in accordance with standard procedures described in PCI "Recommended Practice for Glass Fiber Reinforced Concrete."

3. Cleanliness of equipment and working procedure shall be maintained at all times.

C. Tolerances

1. Dimensional Tolerances of Finished Units

a. Overall height and width of units measured at the face adjacent to the form:
   1). 10 ft. or Under: + 1/8 in.
   2). 10 ft. and Over: + 1/8 in. per 10.
b. Thickness:
   1). Skin Thickness: + 1/4 in., - 0 in.
   2). Architectural Facing Thickness: + 1/8 in., - 0 in.
   3). Side Return Thickness: + 1/2 in., - 0 in.
   4). Panel Depth from Face of Skin to Back of Steel Stud or Integral Rib: + 1/8 in, - 1/4 in.
c. Angular Variation of Plane of Side Mold: 1/32 in. per 3 in. depth or 1/16 in. total, whichever is greater.
d. Variation from Square or Designated Skew (Difference In Length of the Two Diagonal Measurements): 1/8 in. per 6 ft. or 1/4 in. total, whichever is greater.
e. Length and Width of Blockouts and Openings Within One Unit: + 1/4 in.

2. Position Tolerances (Measured from Datum Line Locations as Shown on the Approved Erection Drawings)

a. Steel Studs and Tracks: + 1/4 in.
b. Flashing Reglets, At Edge of Panel: + 1/4 in.

D. Finishes: Exposed face of panels to match approved sample on file in Architect's office. Exposed face of panels shall be manufactured free from joint marks, "grain," or other obvious defects.

1. Face of panels shall receive clear water repellant treatment equal to Lithofin PSI Premium Silicone Impregnator made by VIC International or equal made by ProSoCo.

2. Level of finish for GFRC surfaces exposed to view shall conform to Level 5 of ASTM C 840 and GA-214 of the Gypsum Association. Provide monolithic finish to conceal seams in columns.

3. Panel Finish: Provide custom and texture color as selected by Architect.

4. Sealer: Type recommended by Manufacturer.

E. Cover: Provide embedded anchors, inserts, and other sprayed-in items with sufficient strength anchorage and embedment for design requirements.

F. Curing

1. Immediately after the completion of spraying of the panel, a curing method shall be used to ensure sufficient strength for removing the units from the form.

2. After initial curing, remove panel from form and place in a controlled curing environment. Panels shall be kept continuously wet for a minimum of 7 days in accordance with manufacturer's standard curing practice. The temperature shall be maintained between 60

deg F and 110 deg F during this period. In lieu of moist curing, an acrylic thermoplastic copolymer dispersion shall be used as a curing admixture. Only copolymers shown to eliminate the need for moist curing through published independent laboratory test data shall be used.

G. Acceptance: GFRC units which do not meet the color and texture range or the dimensional tolerances may be rejected at the option of the Architect, if they cannot be satisfactorily corrected replace rejected panels at no extra cost to Owner.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installation of units, the Contractor shall check the job site dimensions affecting the work. Any discrepancies between design dimensions and field dimensions which could adversely affect installation shall be brought to the attention of the Architect. Installation shall not proceed until discrepancies are corrected or until installation requirements are modified and reviewed by the Architect.

B. Examine GFRC components prior to installation.

1. Any piece with flaws, imperfections, dimensional errors, improper tolerances, damage, discolorations, staining, or otherwise not considered suitable and/or acceptable to the Architect, will be subject to rejection.

2. Defective items shall be removed from the job site and replaced to the Architect's satisfaction within 48 hours. Repairs, such as gluing of broken units are not to be allowed.

C. Touch up galvanized steel surfaces which are scratched or damaged, with zinc-rich paint and/or approved "Galvanize Repair" paint products. Clean metal thoroughly before touch up.

3.2 INSTALLATION

A. Contiguous Work: Provide openings and other provisions as shown or required for contiguous work. When directed by the Construction Manager, close up openings in units after other work is in place. Use materials and set to match surrounding units.

B. Setting: Set GFRC units in accordance with drawings and final shop drawings. Provide anchors, supports, fasteners and other attachments shown or necessary to secure work firmly in place. Shim and adjust accessories for proper setting of units.

1. Make necessary provisions for the employment of the suitable lifting devices at points provided by the manufacturer.

2. Erect GFRC units plumb and true with joints uniform in width and accurately aligned within the allowable tolerances.

3. Provide temporary supports and bracings as required to maintain position, stability and alignment when units are being permanently connected. Fasten GFRC units in place by bolting or welding or both as shown on approved erection drawings.

a. Provide slotted holes in connection and attachments to accommodate induced panel movement due to creep, thermal, moisture, field tolerances and dimensional changes in the structural frame.

3.3 CONSTRUCTION TOLERANCES

A. Install GFRC units to comply with the following non-cumulative maximum variations:

1. Tolerance of Face Width of Joint

a. Panel Dimensions 10 Feet or Less: + 3/16".
b. Panel Dimensions 10 to 20 Feet: + 1/4".
c. Panel Dimensions Over 20 Feet: + 5/16".

2. Warpage: Maximum permissible warpage of one corner out of the plane of the other three shall 1/16" per foot distance from the nearest adjacent corner, or 1/4" in. total after installation.

3. Bowing: Not over L/360 with a maximum of 1", where L is the panel length in the direction of the bow. Differential bowing as erected between adjacent members of the same design shall be not more than 1/4".

3.4 ADJUSTMENTS AND CLEANING

A. Remove and replace units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining work. Provide new matching units, install as specified and eliminate evidence of replacement.

B. Clean GFRC units not less than 6 days after completion of work, using clean water and stiff-bristle brushes. Do not use wire brushes, acid type cleaning agents or other cleaning compounds with caustic or harsh fillers.

C. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures work being without damage, discolorations, or deterioration during subsequent construction and until time of substantial completion.

END OF SECTION

SECTION 042000 - UNIT MASONRY

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the unit masonry work as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Exterior concrete block walls (Hi R 10" CMU).
2. Interior smooth concrete block walls.
3. Ground face concrete masonry.
4. Smooth face concrete masonry.
5. Face brick.
6. Metal joint reinforcing, anchors, ties, weeps, closures, and related accessories for masonry.
7. Control and expansion joints in masonry, filled with joint fillers.
8. Through-wall flashing.
9. Cavity drainage material.
10. Chases, recesses, pockets, and openings in masonry as required for installation of work by others.
11. Building in of items furnished by others into masonry, including access doors, door frames, anchors, sleeves and inserts, and other similar items to be embedded in masonry.
12. Grouting in of metal items built into masonry work.
13. Protection, pointing and cleaning of masonry.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Thin-Brick Veneer System - Section 042513.

C. Cast Stone - Section 047200.

D. Cold-Formed Metal Framing - Section 054000.

E. Miscellaneous Metals - Section 055000, for steel lintels.

F. Thermal Insulation - Section 072100.

G. Sheet Metal Flashing - Section 076200.

H. Firestops and Smokeseals - Section 078413.

I. Joint Sealants - Section 079200.

1.4 SUBMITTALS

A. Submit Shop Drawings for the following:

1. Anchoring details., engineered by Contractor.

2. Control and expansion joint locations and details.

3. Special brick shapes.

4. Flashing at typical lintels.

B. Submit Samples for the following:

1. Each type of face brick in sufficient number and color (not less than 5) to show full range of color, texture, and shade. Submit certification that brick meets ASTM standards specified herein.

a. Submit samples of all special shapes required showing color range and sizes.

2. Ground face concrete masonry unit; each type of configuration; full size.

3. Joint reinforcing, each type, width and proposed location (labeled).

4. Anchors, wedges and ties, each type, width and proposed location (labeled).

5. Joint filler, each type.

6. Flashing, including splice sample, 12" long.

7. Mortar color, 12" long cured sample.

C. Submit technical and installation information for the following:

1. Mortar materials, each material and mortar type.

2. Certification of mortar mix.

3. Flashing material, descriptive literature.

4. Concrete block, joint reinforcing, anchors, ties and joint filler; submit manufacturer's technical and descriptive literature.

5. Block manufacturer shall submit certifications of compliance with ASTM C 90, C 331 and UL 618 prior to any job site delivery. Field sampling of concrete block may be tested by an Independent Testing Laboratory retained by the Owner according to the requirements of ASTM C 140.

D. Cleaning Procedures: Submit proposed procedures and materials for cleaning masonry work; including certification that cleaner will not adversely affect stone, gaskets, sealants, etc.

E. Signed and sealed calculations by a Professional Engineer licensed in the State of New York for all anchoring.

1.5 QUALITY ASSURANCE

A. Conform to the following non-cumulative tolerances (any masonry work not meeting these standards shall be re-built as directed by the Architect).

1. Variation from Plumb:

a.	In lines and surfaces of columns, walls and arrises:	
1).	In 10 feet	1/8"
2).	In any story of 25 feet maximum	1/4"
3).	In 40 feet or more	1/4"
b.	For external corners, expansion joints and other conspicuous lines:	
1).	In any story of 25 feet maximum	1/4"
2).	In 40 feet or more	3/8"

2. Variation from the level or the grades indicated on the drawings; for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/4"

3. Variation of the linear building lines from established position in plan related portion of columns and partitions:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/2"

4. Variation in cross-sectional dimensions of columns and in thickness of walls:

a.	Minus	1/8"
b.	Plus	1/8"

5. Variation in dimensions of masonry openings:

a.	Horizontal dimension	-0" + 1/16"
b.	Vertical dimension	+0" - 1/16"

B. Job Installation Mock-Up (as indicated on drawings): Prior to installation of masonry work, erect sample wall panel mock-up using materials, bonding patterns and joint tooling required for final work and including cavity wall, masonry sill, typical pier with returns and stone base, window unit and sill, projecting courses, anchors and reinforcement as detailed. Provide special features as directed by the Architect for caulking and contiguous work. Build mock-up at the site, 4' x 4' size as directed by the Architect, indicating the proposed range of colors, textures and workmanship to be expected in the completed work. Reconstruct mock-up if directed by the Architect until it meets with Architect's approval. Obtain Architect's acceptance of visual qualities of the mock-up before start of masonry work. Retain mock-up during construction as a standard for judging completed masonry work. Do not alter, move or destroy mock-up until

work is completed and accepted by the Architect. Use sample panels to test proposed cleaning procedures after sample panel meets with Architect's approval.

C. Factory Control

1. The Architect reserves the right to visit the brick manufacturer's facility and review pre-sorting so that all brick falls within a color range acceptable to the Architect.

2. 4' x 4' mock-ups shall be constructed at the factory using the face brick specified. This mock-up, after approval of the Architect, shall become the quality control panel for the selected brick.

3. Prior to any shipment of the face brick from the factory, the Architect reserves the right to inspect the brick for the thoroughness of the pre-sorting and to reject any brick that, in his opinion, does not fall within acceptable color range.

D. Work of this Section shall conform to the requirements of the following:

1. 2016 "Building Code Requirements for Masonry Structures," (TMS 402/602-16).

2. 2016 "Specification for Masonry Structures," (TMS 602-16).

3. Brick Industry Association (BIA) "Technical Notes on Brick Construction."

E. Pre-Construction Conference: Prior to installation of masonry and associated work, Contractor shall arrange a meeting with Masonry Subcontractor, installers of related work, and other entities concerned with masonry wall performance, including the Architect and Owner. Contractor shall record discussions and agreements and furnish copy to each participant. Provide at least seventy-two (72) hours' advance notice to participants prior to convening conference. Review methods and procedures related to masonry work, including, but not limited to, the following:

1. Review masonry requirements (drawings, specifications and other Contract Documents).

2. Review required submittals, both completed and yet to be completed.

3. Review and finalize construction schedule related to masonry work and verify availability of materials, installer’s personnel, equipment and facilities needed to make progress and avoid delays.

4. Review required inspection, testing, certifying and material usage accounting procedures.

5. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

6. Coordinate work with air/vapor barrier membrane and related flashing, review details to avoid conflicts.

1.6 PRODUCT HANDLING

A. General: Deliver, store, handle and protect all materials from damage, moisture, dirt and intrusion of foreign matter. Store all masonry units and mortar materials on raised platforms and under ventilated and waterproof cover. Store packaged materials in manufacturer's

unopened containers, marked with manufacturer's name and product brand name. Immediately reseal containers after partial use. Remove and replace damaged materials.

B. Masonry Units: Pack, deliver and store to prevent breakage, cracking, chipping, spalling or other damage. Store, protect and ventilate units at project site.

C. Aggregate: Store with provisions for good drainage.

D. Reinforcement and Anchors: Store and protect so that when placed, joint reinforcement and anchors will be free of soil, dirt, ice, loose rust, scale, or other coatings which would destroy or reduce bond with mortar and will not be disfigured or bent out of shape.

1.7 TESTING FOR EFFLORESCENCE

A. Test selected face brick for efflorescence in accordance with ASTM C 67.

B. If, at the end of the test period, the samples of brick or mortar show efflorescence, the materials represented shall be rejected and new materials shall be re-tested. This process shall be repeated until no efflorescence appears. Testing shall be done by an independent testing laboratory at the expense of the Contractor; submit test results in writing to the Architect.

1.8 JOB CONDITIONS

A. In cold weather, when the outside temperature is below forty (40) deg. F., conform to the requirements of "Cold Weather Masonry Construction and Protection Recommendations" publication by Brick Industry Association (BIA). No anti-freeze admixtures are permitted.

1. In addition, conform to the following:

a. Masonry materials must be warmed as required.
b. Brickwork must be protected a minimum of 24 hours after installation so as to maintain enough heat for hydration of the cement in the mortar.

B. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg. F. and above. In addition, conform to the following:

1. Masonry materials must be cool.

2. Mortar must be used within 2 hours of initial mixing.

C. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24" down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24" down face next to unconstructed wythe and hold cover in place.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.

1.9 ATTIC STOCK

A. Provide additional 10% of dry mortar mix labeled, packaged, and delivered to location determined by Owner for attic stock.

B. Provide additional 5% of brick labeled, packaged, and delivered to location determined by Owner for attic stock.

PART 2 PRODUCTS

2.1 GENERAL

A. Comply with NCMA guidelines for controlling efflorescence.

2.2 MATERIALS

A. Standard Concrete Block

1. Portland cement, ASTM C 150, Type 1, low alkali (less than 0.6%), single source for entire project.

2. Aggregates, ASTM C 331, lightweight expanded shale, clay or slate aggregates, manufactured by the rotary kiln process equal to "Solite," "Norlite," or "Haydite."

a. Block scheduled to receive painted finish shall contain normal weight aggregate meeting ASTM C 331 in addition to lightweight aggregate in order to receive a smooth, uniform finish.

3. Concrete Masonry Units: Load bearing lightweight aggregate concrete masonry units conforming to the requirements of ASTM C 90, Type 1.

a. Block behind face brick and block for rated walls shall be 75% solid units.
b. All other block may be hollow units.

4. The producer of the concrete masonry units shall furnish certification from an independent testing laboratory confirming that all 8" or larger masonry units meet all of the UL 618 requirements for two (2) hours or better (as required), referencing full scale fire test

reports (ASTM E 119). All 4" and 6" units shall conform to "National Bureau of Standards" and "National Research Council" full scale fire tests.

5. Sizes and Shapes: Nominal face size 8" x 16" by thickness as indicated on drawings, with stretcher units, jamb units, header units, square corner units (at ends and corners of exposed or painted work), sash units (at control joints within masonry wall), lintel units and other special shapes and sizes required to complete the work.

6. Exposed Faces

   a. Standard CMU: For exposed or painted block surfaces, in addition to ASTM requirements, block shall have uniformly dense, flat, fine grain texture, with no cracks, chips, spalls, or other defects which would impair appearance.
   b. Smooth CMU: by Janis in color selected by Architect.
   c. Polished Ground Face CMU: Provide polished ground face units for indicated wall construction, including special shapes, as required; provide "Gemstone Plus" as manufactured by York Building Products, or comparable product by Trenwyth Industries Inc., Anchor Concrete Products, E.P. Henry Corp., or approved equal.
      1). Match Architect's sample for color, pattern, and texture of ground face units.

7. Insulated CMU: Grand Blac Cement Products Korfil Hi-R Masonry Systems integral block and insulation.

8. For concealed CMU, surfaces shall be free from deleterious materials that would stain plaster or corrode metal.

9. Curing: All concrete block shall be steam cured, and air dried for not less than thirty (30) days before delivery.

10. Density of concrete block shall not exceed one hundred and five (105) lbs. per cubic foot.

11. Shrinkage: Shrinkage of concrete blocks shall not exceed 0.065% when tested in accordance with ASTM C 426-16, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

12. Water Content

    a. At the time of delivery to the job site, concrete masonry units shall have a value, in weight of contained water, of not more than thirty (30) percent of the fully saturated content for the unit tested.
    b. Ship all units from the factory, and store at the job site, with all necessary protection to prevent increase of water content from rain and other sources.

B. Brick

1. Manufacturer: Pacific Clay Products, Inc., color as scheduled on the drawings; or approved equal.

2. Size and Color: As indicated on the drawings.

3. Facing Brick: ASTM C 216, Grade SW, Type FBX.

4. Where brick is fully concealed provide common brick conforming to ASTM C 62, Grade SW.

5. Provide all special molded shapes as indicated on the drawings.

6. For sills, caps and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide uncored units with all exposed surfaces finished.

C. Joint Reinforcing for Masonry Walls

1. For anchoring face brick to CMU back-up, provide "280 S.I.S. Dub'l Loop-Lok Seismiclip Interlock System" as manufactured by Hohmann & Barnard or equal by manufacturer noted below in Para. C.5. All wire used in assembly shall be 3/16" dia. Assembly shall contain ladder reinforcing, welded loops, box tie, seismiclip and continuous wire in face brick mortar joint. Provide special formed prefabricated pieces at corners and intersections of walls or partitions. Reinforcing wire in face brick mortar joint to extend at least 2" into face of brick. Show anchor locations on approved shop drawings.

   a. Reinforcing assembly shall be hot dip galvanized steel finish conforming to ASTM A 153 with zinc coating of 1.5 oz. of zinc per sq. ft, after fabrication.

2. For block walls forming part of exterior wall construction behind exterior stone veneer, provide super heavy duty reinforcing fabricated of 3/16" dia. side and cross rods, truss or ladder design, ties, spaced every block course. Provide prefabricated pieces at corners and intersections of walls or partitions.

   a. Reinforcing assembly shall be hot dip galvanized steel finish conforming to ASTM A 153 with zinc coating of 1.5 oz. of zinc per sq. ft., after fabrication.

3. For interior block walls and partitions, provide standard reinforcing fabricated of 9 ga. side and cross rods, truss or ladder design, no ties, spaced every other block course. Provide prefabricated pieces at corners and intersections of walls or partitions. Reinforcing shall be mill galvanized conforming to ASTM A 641, Class B-1, applied after fabrication.

4. Wire used in assemblies noted above shall be cold drawn steel wire conforming to ASTM A 82.

5. Approved Joint Reinforcing Manufacturers

   a. Hohmann & Barnard
   b. Wire-Bond
   c. Heckmann Building Products
   d. National Wire Products Industries, Inc.

D. Anchors and Ties

1. For anchoring brick to cold-formed metal framing, provide one of the following or approved equal by other manufacturers noted above in Para. C.5:

   a. "Wing-Nut Pos-I-Tie" with self-drilling screw for steel studs zinc barrel and thermal wing nut as manufactured by Heckmann Building Products. Provide "Seismic Wire Pintle Tie" hot-dip galvanized steel.
   b. Hot-dip galvanized steel anchors equal to "X-Seal Veneer Anchor" with "X-Seal Tape" as manufactured by Hohmann & Barnard or approved equal. Provide Model 187 "Seismiclip" with 9 gauge wire.

2. Dovetail Anchor Slots: Hot-dip galvanized steel, 16 gauge, equal to No. 100 Dovetail Anchor Slot made by Heckmann Building Products, No. 305 anchor slot made by Hohmann & Barnard, or approved equal by other manufacturers in Para. C.5.

3. Flexible Metal Ties for Dovetail Slots: Hot-dip galvanized, 16 gauge by 1" wide by Heckmann Building Products Inc., or approved equal manufacturer noted above in Para. C.5.

    a. No. 106 Dovetail Corrugated Anchor.
    b. No. 129 Dovetail Triangle Tie.

4. Wire Mesh: Hot-dip galvanized sixteen (16) gauge steel wire, square mesh, width 3" by length to suit condition; No. 268 by Heckmann Building Products, or approved equal by manufacturer noted above in Para. C.5.

5. For anchoring face brick to concrete back-up where there are no dovetail slots provided, provide "CMU/Concrete Screw Wing-Nut Pos-I-Tie" with five (5) gauge hot-dip galvanized (ASTM A 153, Class B-2) wire pintle tie made by Heckmann Building Products, or approved equal by manufacturer noted above in Para. C.5.

6. For anchoring CMU wall, at the exterior masonry cavity wall, to the underside of the concrete beam, provide dovetail slot as noted above and the following:

    a. No. 121 galvanized steel dowel anchor and No. 421 tube as manufactured by Heckmann Building Products or approved by manufacturer noted above in Para. C.5. Galvanized to conform to ASTM A 153, Class B-2.
    b. No. PTA-310 galvanized steel dowel anchor and No. NS-TA joint filler as manufactured by Hohmann & Barnard or approved equal by manufacturer noted above in Para. C.5. Galvanizing to conform to ASTM A 153, Class B-2.

7. For anchoring masonry to structural steel, provide hot-dip galvanized steel, as listed, or approved equal by manufacturer noted above in Para. C.5:

    a. Made by Heckmann Building Products. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
        1). No. 195 Column Anchors.
        2). No. 197 Column Anchors.
        3). No. 315 Weld-On Anchor Rods with No. 316 Triangle Ties.
        4). No. 315-B Weld-On Anchor Straps with No. 316 Triangle Ties.
    b. Made by Hohmann & Barnard or approved equal. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
        1). No. 355 Column Anchors.
        2). No. 356 Column Anchors.
        3). No. 357 Beam Anchors.
        4). No. 359 F anchor straps with VWT tie.

8. For anchoring CMU interior partitions to underside of steel beams, provide hot dip galvanized steel tube anchors equal to No. 419 and No. 421 made by Heckmann Building Products, No. PTA-420 made by Hohmann & Barnard, or approved equal by manufacturer noted above in Para. C.5.

9. For anchoring CMU interior partitions to underside of structural deck, provide 4" x 4" x 1/4" galvanized steel angles (ASTM A 36), 3'-0" long spaced 3'-0" o.c. alternately on each side of partition. Anchor partition securely to structural deck.

E. Reinforcing Bars and Rods: ASTM A 615, Grade 60. See Drawings for size.

F. Control and Expansion Joint Fillers

1. Vertical Installation Within Concrete Masonry Wall: Extruded high-grade neoprene rubber, cross shape, for use with concrete masonry sash units, which shall provide a force fit in the grooves of the sash block and shall have 1/2" diameter tubular ends (compressed 25% when installed in 3/8" wide joint).

   a. Provide the following sizes:
      1). 2-5/8" wide control joint fillers for 4" block walls.
      2). 4-5/8" wide for 6" block walls.
      3). 6-5/8" wide for 8", 10" and 12" block walls.
   b. Provide backer rod and sealant joint over joint filler as per drawings and Section 079200 of these specifications.

2. Isolation Joint Filler at Abutting Construction and at Intersecting CMU Walls: Compressible and resilient closed cell neoprene gasket with pressure sensitive adhesive backing, thickness 30% greater than thickness of joint. Acceptable joint filler shall be "Everlastic, Type NN-1" by Williams Products, Inc., or approved equal. Recess joint filler and install backer rod and sealant as per drawings and Section 079200 of these specifications.

3. Within Face Brick: Provide filler rod and sealant installed by Section 079200. Filler depth shall be 2 times joint width.

   a. Compressible filler between top of brick and bottom of shelf angle shall be "Soft Joint Sealant" made by Polytite, or approved equal.

4. Within Expansion Joint at Face Brick: Manufacturer's standard preformed, pre-compressed, open-cell polyurethane foam sealant impregnated with a water based, non-drying polymer modified acrylic water repellent. Provide "Seismic Colorseal" installed to twenty-five 25 percent compression, as manufactured by Emseal or approved equal.

   a. Properties: Permanently elastic, mildew resistant, non-migratory, non-staining, and compatible with joint substrates and other joint sealants. Density: 8.4 to 9.1 lb./cu. ft.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type 1, standard color, one source.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: Clean, washed, buff colored sand, graded per ASTM C 144.

D. Aggregate for Grout: ASTM C 404.

E. Water: Clean, fresh and suitable for drinking.

2.4 MORTAR MIX

A. Exterior Face Brick Construction: Mortar mixes shall meet ASTM C 270, Type N, cement/lime mortar. Colors of mortars shall use coloring agent made by Davis Colors, Lehigh Cement or approved equal. Color of mortar to meet with Architect's approval. The Contractor may use pre-packaged colored mortar equal to "Color Mortar Blend" made by Glen-Gery.

1. Color of mortar must match Architect’s approved sample and mock-up panel.

B. Exterior Block Back-Up Construction: Provide Portland cement/lime mortar as noted above conforming to ASTM C 270, Type N.

C. Interior Masonry Construction: Provide Portland cement/lime mortar conforming to ASTM C 270, Type N, for load bearing conditions, mortar shall conform to ASTM C 270, Type M.

D. Reinforced Concrete Block: Provide Portland cement/lime mortar conforming to ASTM C 270, Type S.

E. Mortar for Cement Cants: One (1) part Portland cement and four (4) parts sand, by volume.

F. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of unit masonry. Use grout of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Grout shall have a minimum compressive strength of 3000 psi when tested in accordance with ASTM C 1019.

G. Mixing

1. General: Add cement just before mixing and mix dry. Use sufficient amount of water as necessary to produce workable mix. Mix in small batches to make plastic mass.

2. Mixing: Machine mix all mortars in approved type mixer with device to accurately and uniformly control water. Add hydrated lime dry. Mix dry materials not less than two (2) minutes. Add water, then mix not less than three (3) minutes, not to exceed five (5) minutes. Mix only amount of mortar that can be used before initial set. Do not use mortar which has reached its initial set or two (2) hours after initial mixing, whichever comes earlier. Mortar may not be re-tempered. Clean mixer for each batch, whenever mortar type is changed, and at end of each day's work.

3. Acceleration or other admixtures not permitted.

4. Mortar shall have a flow after suction of not less than seventy-five (75) percent of that immediately after mixing as determined by ASTM C 91.

H. Admixtures

1. No air-entraining admixtures or cementitious materials containing air-entraining admixtures shall be used in the mortar.

2. No antifreeze compounds or other substances shall be used in the mortar to lower the freezing point.

3. Calcium chloride or admixtures containing calcium chloride shall not be used in mortar.

2.5 MASONRY ACCESSORIES

A. Neoprene Joint Filler: Provide closed cell neoprene, Type NN-1, conforming to ASTM D 1056, Grade 1, high performance, as manufactured by Williams Products Inc., or equal made by D. S. Brown, Norton, or approved equal.

B. Rainscreen Drainage Plane: "Fire-Rated Sure Cavity" as manufactured by Masonry Technology Incorporated (MCI), high-impact polystyrene sheets, 0.024" thick, formed with corrugations and a spunbond polypropylene fabric, charcoal color, attached on one side with a 4 inch overlapping skirt on one edge. Conforms to ASTM E84, Class A/ Class 1.

C. Weep Holes: "Cavity Weep," CV 5010 as manufactured by Masonry Technology Incorporated (MCI), high-impact polystyrene sheets, 0.024" thick, formed with corrugations, 2-1/4" wide weep legs at 9-1/2" o.c., and 3/16" channel depth.

D. Through-Wall Flashing: Provide sheet membrane flashing as part of exterior wall membrane system. Provide sealants and tapes as recommended by the manufacturer. Provide preformed corner sections "end dams" with system when flashing is discontinuous.

1. Provide flashing for surface adhered applications at sheathed areas with 26 ga. stainless steel termination bar.

2. Wall flashing shall have 26 ga. stainless steel drip edge adhered to edge of flashing, drip edge shall be set in sealant as specified in Section 079200.

E. Cavity Drainage Material: Provide 10" high HDPE "Mortar Net" open mesh mortar net of width to fit masonry cavity shown on drawings, manufactured by Hohmann & Barnard, Inc., or equal "Mortar Break II," made by Advanced Building Products.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that masonry may be completed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

3. Do not start any work until mock-ups are approved by the Architect.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Architect in writing.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3. Starting of work by the Contractor means acceptance by the Contractor of the substrate.

3.2 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 PREPARATION

A. Brick

1. Wet brick having an initial rate of absorption greater than 30 grams per 30 square inches when tested per ASTM C 67. Wet bricks by allowing water to run on the cubes or pallets of brick, or placing them in a large tank of water.

2. Except for absorbent units specified to be wetted, lay masonry units dry.

B. Concrete Block: Do not wet concrete block units.

3.4 INSTALLATION

A. General

1. Build walls to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown.

2. Build chases and recesses as shown or required for the work of other trades.

3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

4. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement type joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible.

5. Lay up walls plumb and true with courses level, accurately spaced and coordinated with other work.

6. Provide templates made of steel studs for plumbing of two-story masonry openings.

7. Pattern Bond: Lay exposed masonry patterns as noted on drawings. If not shown, provide running bond. Lay concealed concrete block with all units in a wythe bonded by lapping not less than two (2) inches. Bond and interlock each course of each wythe at corners. Do not use units of less than four (4) inches horizontal face dimensions at corners or jambs.

8. Where possible, masonry walls and partitions shall be built after all overhead ducts, pipes and conduits are in place and tested. Masonry shall be neatly built around the items above. Walls and partitions shall be plumb, true to line and free from defects such as open cells, voids, dry joints and other similar defects. In rooms and spaces scheduled to have concrete block finish, all such surfaces including upper wall surfaces up to termination of structural ceiling in spaces without suspended ceilings, shall be made suitable for paint application. Cutting of openings in walls and partitions in place shall be done only with the approval of the Architect.

9. Do not use any bricks that do not meet chippage and tolerances of the applicable ASTM standard noted herein for the grade, type or class of brick.

10. Mortar, ties, and reinforcement must not extend into or bridge any expansion joints.

11. For best appearance and water resistance, tuckpoint scored joints on interior and exterior applications.

B. Mortar Bedding and Jointing

1. All joints between bricks shall be completely filled with mortar. Bed joints shall be beveled per BMI recommendations, with the brick then shoved in place. At cavity wall construction, care shall be taken that no excess mortar goes into masonry cavity. Head joints shall be completely filled with mortar and shall be formed by applying a full coat of mortar to the entire end or the entire side, as the case requires, and then shoving the mortar covered end and/or side of the brick tightly against the bricks previously laid; the practice of "slushing" by throwing mortar into the head joints will not be permitted. All brick shall be laid without disturbing the brick previously laid. Brick shall be laid within a minute or so after the mortar is placed. Dry or butt joints will not be permitted. Grouting shall be done only as necessary. Do not slush head joints.

2. After brick placement, mortar squeezed out of bed joints shall be cut off before tooling.

3. Lay concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on exterior walls and in all courses of piers, columns and pilasters, where solid CMU is used and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.

   a. To ensure alignment of brick and block coursing, adjust block back-up by cutting block to insure alignment of coursing or use adjustable anchorage.

4. Lay masonry walls with 3/8" joints unless otherwise shown on drawings.

5. Tool exposed joints slightly concave after the mortar joint is thumbprint hard. Concealed joints shall be struck flush, including at any CMU schedule to receive a waterproofing or air barrier membrane.

6. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stopping and Resuming Work: Rake back 1/2 brick length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

D. Built-In Work

1. As the work progresses, build in items specified under this and other Sections of these specifications. Fill in solidly with masonry around built-in items.

2. Mortar in door frames, access doors, louvers and other metal items embedded or built into masonry work solidly with mortar as the masonry units are laid up.

3. Grout under lintels, bearing plates, and steel bearing on masonry with solid bed grout.

4. Sleeves, pipes, ducts and all other items which pass through masonry walls shall be caulked with interior grade sealant meeting requirements of Section 079200, so as to be airtight and prevent air leakage. Refer to Section 078413 for packing of voids in rated masonry walls.

5. Fill vertical cells of masonry units solid with grout which have anchoring, reinforcing rods, supporting or hanging devices embedded in the cell including stone anchors and window or curtain wall anchors.

6. Fill vertical cells of masonry units solid with mortar on each side of door frames to sixteen (16) inches beyond.

7. Unless otherwise noted, fill vertical cells of masonry units solid with grout which are below steel bearing plates, steel beams, and ends of lintels, to eight (8) inches beyond bearing and from floor to bearing.

8. Place wire mesh in horizontal joint below masonry unit cells to be filled with mortar, to prevent mortar from dropping into unfilled cells below.

9. Masonry indicated as being reinforced shall have all voids filled solid with grout. Grout shall be consolidated in place by vibration or other methods which insure complete filling of cells. When the least clear dimension of the grouted cell is less than two (2) inches, the maximum height of grout pour shall not exceed twelve (12) inches. When the least clear dimension is two (2) inches or more, maximum height of grout pour shall not exceed forty-eight (48) inches. When grouting is stopped for one (1) hour or longer, the grout pour shall be stopped 1-1/2" below the top of a masonry unit. Vertical bar reinforcing shall be accurately placed and held in position while being grouted and shall be in place before grouting starts. All such reinforcing shall have a minimum clear cover of 5/8". Lap all bars a minimum of forty (40) bar diameters and provide steel spacer ties (not to exceed 192 bar diameter) to secure and position all vertical steel and prevent displacement during grouting. Provide continuous horizontal reinforcement embedded in mortar joints every second course.

10. Coordinate masonry with electrical outlets and wiring conduits as required.

E. Cutting and Patching

1. All exposed masonry which requires cutting or fitting shall be cut accurately to size with motorized carborundum or diamond saw, producing cut edges.

2. Do not saw cut any masonry openings in face brick construction without Architect's approval and after a procedure has been reviewed and approved.

3. Holes made in exposed masonry units for attachment of handrail brackets and similar items shall be neatly drilled to proper size.

4. All masonry which requires patching in exposed work, if approved by Architect, shall be patched neatly with mortar to match appearance of masonry as closely as possible and to the Architect's satisfaction. Rake back joints and use pointing mortar to match as required.

F. Solid Wall Construction

1. Fill the vertical longitudinal joint between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging.

2. Tie wythes with continuous horizontal reinforcement embedded in mortar joints sixteen (16) inches o.c. vertically.

G. Cavity Walls

1. All exterior masonry walls, unless otherwise indicated, shall be cavity walls of thickness indicated.

2. Two wythes of masonry cavity walls shall be securely tied together by horizontal joint reinforcement and ties anchored to reinforcement, as herein specified, spaced every other block course.

   a. Where cavity back-up is concrete use ties specified herein spaced sixteen (16) inches o.c. both directions.

3. Cavity between facing and backing wythe shall be kept clean and clear of all mortar droppings, and no mortar ledges shall project into the cavity. Temporary wood strips, cut to width of cavity and fitted with lift-up wires, shall be laid on the joint reinforcement and carefully lifted out before placement of the next layer of reinforcement. Any projecting mortar shall be spread over the back of the outer wythe immediately following the setting of the masonry unit.

   a. Cavity drainage material shall be installed at the bottom of each cavity over the flashing to protect weep holes.

4. At cavity and solid walls adjacent to window openings fill block solid with mortar where window anchors are to be located. Coordinate with window subcontractor.

5. Concrete block back-up at cavity wall construction shall be anchored to slab at top with dovetail anchors spaced sixteen (16) inches o.c.

6. Anchor CMU back-up with anchors as specified herein.

7. Where stone veneer, as specified in Section 044200, is used in cavity wall configuration, back-up block shall be reinforced every block course.

H. Interior Block Walls

1. Build to full height unless otherwise shown on drawings. At non-rated partitions fill void between CMU and structural deck with continuous neoprene filler as specified herein. At fire-rated partitions, fill void with fire stop material meeting the requirements of Section 078413. Fasten to structure at top of partition using steel angles as specified herein.

2. Provide continuous horizontal joint reinforcing every other block course, except as otherwise noted. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8". Lap reinforcement a minimum of six (6) inches at ends of units.

3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

4. Corners

    a. Provide interlocking masonry unit bond in each course at corners.
    b. Provide continuity at corners with prefabricated "L" reinforcement units, in addition to masonry bonding.

5. Intersecting and Abutting Walls

    a. Unless vertical control joints are shown as part of structural frame, provide interlocking masonry bond. Provide starters and special shapes as shown on the drawings to bond these walls.
    b. In addition to masonry bonding, provide horizontal reinforcement using prefabricated "T" units at interior partitions.

I. Ties and Anchors for Masonry Construction

1. Provide ties and anchors as shown or specified, but not less than one metal tie, spaced not to exceed 16" o.c. horizontally and/or vertically. Provide additional ties within 1'-0" of all openings and adjacent to expansion joints and spaced not more than 16" apart around perimeter of openings.

2. Anchoring Masonry to Structure: Provide an open space not less than 1/2" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.

3. Attach brick veneer to cold-formed metal framing by anchoring brick to studs using specified anchors penetrating through sheathing and through flange of stud. Prior to application of anchors cover sheathing and vapor barrier with tape specified herein. Space anchors 8" o.c. at each stud; provide stainless steel screw anchors for attaching anchor to studs.

J. Control and Expansion Joints

1. Provide expansion, control and isolation joints in masonry as shown. Build in related items as the masonry work progresses.

2. CMU Control Joint Spacing: If location of control joints is not shown, place vertical joints spaced not to exceed 40'-0" o.c. In addition, locate joints at points of natural weakness in the masonry work, including the following:

    a. At structural column or joint between bay.
    b. Above control joints in the supporting structure.
    c. Above major openings at end of lintels upward and below at ends of sills downward. Place at one side of jamb for openings not less than 6'-0" wide and at both sides for openings over 6'-0" wide.
    d. At reduction of wall thickness.
    e. Where masonry abuts supporting structure.
    f. If additional joints are required, indicate same on approved shop drawings.

3. Brick Veneer Expansion Joint Spacing: Vertical expansion joints in brick veneer construction shall be located maximum 20'-0" o.c. unless otherwise noted in addition to expansion joints located within 2'-0" of each corner of the building.

K. Lintels

1. Install loose steel lintels furnished by Section 055000, allowing eight (8) inch bearing at ends.

2. For concrete block walls, use specially formed U-shaped concrete block lintel units with reinforcing bars in accordance with the following table, filled with grout.

Number and Size of Reinforcing Bars Required at Concrete Block Lintels		
Maximum Clearance Span	Wall Width	Rebar No. - Size
2'-0" to 6'-0" 6'-0" to 8'-0"	6"	2 - #3 2 - #4
2'-0" to 6'-0" 6'-0" to 8'-0"	8"	2 - #3 2 - #4
2'-0" to 6'-0" 6'-0" to 8'-0"	12"	3 - #3 3- #4

3. U-shaped concrete block lintels shall extend a minimum of 8" at each side of opening.

3.5 FLASHING/WEEP HOLES

A. General: Install embedded flashing and weep holes in masonry at relieving angles, shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated. Space weeps 16" o.c. unless otherwise shown on drawings. Weeps shall occur immediately above the flashing.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing.

C. Flashing shall be placed, generally, at bottoms of cavity wall construction, over all wall openings, window jambs, at sills of window, and in other locations where indicated on the drawings. Flashing shall overlap a minimum of 6". At bottoms of cavity walls, the flashing shall be built extending from the exterior face of the brick, up and into the mortar joint 2" at the inner wythe of the CMU back-up; at sheathed areas attached with pressure bar. At concrete spandrel beams and columns, the flashing shall be installed with a termination bar. Extreme care shall be exercised in placing the masonry materials not to damage the flashing. Flashing damaged during the masonry erection shall be repaired or replaced by the Contractor at no additional cost to the Owner. Discontinuous flashing shall terminate with an end dam in a head joint, rising at least 1".

D. When spanning an air space, flashing shall be supported with a mortar wash, insulation or treated wood blocking.

E. Where flashing is penetrated by anchors, patch flashings at penetration using adhesive and mastic recommended by the manufacturer to insure watertight seal.

F. Install flashing in accordance with manufacturer's instructions, using adhesive, primer, thinner, cleaner and mastic as recommended by flashing manufacturer.

1. Flashing shall overlap adjacent piece of flashing a minimum of 6".

G. Provide drip edge when flashing extends beyond face of brick.

3.6 CLEANING, PROTECTION, ADJUSTMENT

A. Protection

1. The Contractor shall take adequate precautions for the protection of all surfaces against mortar spatter and shall immediately remove any such spatter should it inadvertently occur, leaving no stain or discoloration.

2. Excess mortar shall be wiped off the masonry surfaces as the work progresses.

3. Wood coverings shall be placed over all such masonry surfaces as are likely to be damaged during the progress of the entire project.

4. Protective measures shall be performed in a manner satisfactory to the Architect.

5. Damaged masonry units shall be replaced to satisfaction of the Architect.

6. Exterior masonry walls shall be draped with waterproof covering until copings are in place, to prevent water penetration in cavity.

B. Cleaning of Masonry: Upon completion, all exposed masonry shall be thoroughly cleaned following recommendations of the BIA Technical Note No. 20. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 4' x 4' in a location approved by the Architect. No further cleaning work may proceed until the sample area has been approved by the Architect, after which time the same cleaning materials and method shall be used on the remaining wall area. If stiff brushes and water do not suffice, the surface shall be thoroughly saturated with clear water and then scrubbed with a solution of an approved detergent masonry cleaner, equal to "Vana Trol" made by ProSoCo Inc. or equal made by Diedrich or approved equal, mixed as per manufacturer's directions, followed immediately by a thorough rinsing with clear water. All lintels and other corrodible parts shall be thoroughly protected during cleaning.

1. Unless otherwise required by cleaning agent manufacturer use only low-pressure device (30 to 50 psi) for application of cleaning agent and water rinsing.

C. Pointing: Point any defective joint with mortar identical with that specified for that joint.

END OF SECTION

SECTION 042513 - THIN-BRICK VENEER PANEL SYSTEM

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the thin brick veneer system as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Cast in concrete – Section 033000.

B. Unit masonry – Section 042000.

C. Structural steel – Section 051200.

D. Cold formed metal framing – Section 054000.

E. Carpentry – Section062000.

F. Thermal insulation – Section 072100.

1.4 REFERENCES

A. ASTM International (ASTM):

1. ASTM C 216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); severe weather grade kiln-fired brick.

2. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; specially formulated mortar mix.

3. ASTM C 513 - Standard Test Method for Obtaining and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength; for bricks, minimum compression strength of 1000 PSI.

4. ASTM C 577 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

5. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing, brick, pass.

6. ASTM C 1088 - Standard Test Method for Thin Veneer Brick Units Made

7. from Clay or Shale; severe weather grade kiln-fired brick.

8. ASTM E 84 - Standard Test Method for Surface Burning Characteristics

9. of Building Materials.

10. ASTM E 754 - Standard Test Method for Pullout Resistance of Ties and

11. anchors Embedded in Masonry Mortar Joints.

1.5 QUALITY ASSURANCE

A. Qualified Installers: Approved by thin brick manufacturer.

1.6 SUBMITTALS

A. Product data indicating thin brick selections.

B. Samples

1. Four (4) sets of samples at least 8" x 12" of 3 courses 1-1/2 bricks long.

2. Indicate range of color and texture.

C. Shop Drawings: Elevations and detail sections of thin brick installation. Indicate anchorage and joint details, and relation to adjacent work.

D. Material Certificates: Prior to delivery to site, submit to Architect and Engineer certificates indicating compliance with the applicable specifications for Thin Brick Grades, Types or Classes included in these specifications.

E. Thin Brick Test Reports: Submit test reports substantiating compliance with requirements. Sample and test in accordance with ASTM C 67.

1. Testing and reports shall be completed by an independent laboratory.

a. Test reports for each type of brick shall be submitted to the Architect and Engineer for review.
b. Thin brick test reports shall indicate:
1). 2-hour cold water absorption.
2). 5-hour boil absorption.
3). Saturation coefficient.
4). Initial rate of absorption.
5). Efflorescence.

F. Mock-Up/ Sample Panel: Sample or mock-up panels shall be used to review installation process as well as thin brick and mortar color and shall serve as the standard of workmanship for the Project.

1. Build mock-up panel for walls to receive Wall System as shown on drawings.

2. Build mock-up panels for Wall System in sizes approximately 4' x 4' by full height.

a. All thin brick shipped for the sample shall be included in the panel.
b. Use panel as standard of comparison for all masonry work built of same material.
c. Where masonry is to match existing, erect panel adjacent and parallel to existing surface.

d. Clean one-half of exposed faces of panel with masonry cleaner as indicated and approved by manufacturer.
e. Approval of panel is for color, texture, and blending of masonry units; relationship of mortar to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
f. Do not start work until Architect/Engineer/Owner has accepted sample panel.
g. Do not destroy or move panel until work is completed and accepted by Architect, Engineer and Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's unopened containers, identified with name, brand, type, and grade.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store thin brick and accessories off the ground, to prevent contamination by mud, dust or other materials likely to cause staining or other defects.

D. Protect materials from contamination, dampness, freezing, or overheating in accordance with manufacturer's instructions.

E. Store different types of materials separately.

F. Mastic and mortar additive are to be stored above 32 deg F and below 86 deg F temperatures and not in direct sunlight.

G. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

B. Protection of Work: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

C. Stain Prevention

1. Prevent adhesive, and mortar from staining the face of masonry.

2. Remove immediately grout or mortar in contact with face of such masonry.

3. To avoid smearing of adhesive on the face of masonry. Allow adhesive on face of installed masonry to set before trying to remove.

4. Protect all sills, ledges and projections from droppings of adhesive or mortar.

5. Protect the wall from rain-splashed mud and mortar splatter.

6. Turn scaffold boards closest to the wall on edge when work is not in progress to prevent rain from splashing mortar and dirt onto masonry.

D. Cold Weather Requirements:

1. Do not use frozen materials or materials mixed or coated with ice or frost.

2. Do not build on frozen substrates.

3. Remove and replace unit masonry damaged by frost or by freezing conditions.

4. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE

5. Comply with manufacturer adhesive application and temperature requirements as stated in the manufacturer installation manual.

E. Hot Weather Requirements:

1. Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE

2. Protect mortar from uneven and excessive evaporation.

a. The face of the installed thin brick may be dampened with water prior mortar installation to reduce the absorption of moisture from the mortar joint and increase bond
b. Veneer may be fogged with water to allow the mortar enough time to set. Apply only enough moisture to consistently dampen the wall without allowing water to run down the face.

3. Comply with thin brick manufacturer's application and temperature requirements.

4. Protect and shade panels from extended exposure direct sun. Excessive heat gain can cause adhesive to flow.

1.9 WARRANTY

A. Warranty shall be manufacturer's full twenty (20) year system warranty, covering all components; panel, adhesive, silicone, membrane, fasteners, etc.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers:

1. "Brick-It-Thick Set G 60 System" as manufactured by Brick-It, 17 Central Ave. Unit 3 ; Hauppauge, NY 11788; Tel: 631-244-3993; Fax: 631-348-0300; Email: request info (info@brickit.com); Web: www.brickit.com

2. "Tabs II," as manufactured by Tabs Wall System, LLC, Grandville, MI 49418.

3. Approved equal.

B. Brick: Kiln-fired brick, 3/4" nominal thickness, meeting ASTM C216 (cut brick) and/or ASTM C1088 (for extruded thin Brick), Grade TBX, FBS, FBX and/or PCI requirements minimum compression strength of 1000 PSI per ASTM C 513. Thin brick shall be thick set following

manufacturer's and TCNA installations. Thin brick shall look identical to the exterior brick. Corner, edge, and corner edge units shall be fabricated or cut from larger brick so that the return legs appear consistent with the exterior face brick.

1. Brick color: to be chosen and approved by Architect from approved manufacture

2.2 SETTING MATERIALS AND GROUT

A. Portland Cement Mortar (Thick Set) Installation Materials: ANSI A108.1A and as specified below:

1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 thick.

2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2" x 2" x 0.062" diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.

3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847. Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath. Self-furring.

4. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.

B. Water: Clean, fresh, and suitable for drinking.

C. Grout complying with A118.7; and ISO 13007, CG2WAF: For grouting thin brick, provide a commercial Portland cement grout "Ultracolor Plus" (additive not required) made by MAPEI or Laticrete Sanded Grout with required Latex Additive or approved equal; color as selected by the Architect. Add latex additive to grout made by same manufacturer as grout.

D. Mortar: Premixed mortar supplied by manufacturer, ASTM C 270.

1. Mortar Color: As selected by the Architect from manufacturer's full range of standard available mortar color options

E. Fasteners: Non-corrosive ribbed nails, screws or staples, designed for applicable substrate.

F. Adhesives: High solid, solvent based adhesive that remains flexible and unaffected by freeze-thaw cycles, as supplied by brick system manufacturer.

G. Cleaner: ProSoCo SureKleen 600 or approved equal.

H. Masonry Sealer: Manufacturer's recommended sealer, applied to brick and mortar joints.

I. Sealant Systems: Acceptable to manufacturer, color as selected by Architect. Joint design and surface preparation shall be based on sealant manufacturer's recommendation and project conditions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation, examine substrate for conditions including soundness, tightness of connections, crumbling or looseness of surfaces, and projections. Verify that substrate is acceptable to authorities having jurisdiction prior to installation of the work of this Section.

B. Report to the Contractor any deviations from the requirements of project specifications or other conditions that might adversely affect the installation. Do not start work until deviations are corrected.

3.2 SUBSTRATE PREPARATION

A. Repair damaged or cracked surfaces. Prepare substrate to be flat, within 1/8 inch within any 4 foot square area.

B. Remove surface contaminants on concrete and concrete masonry surfaces, such a form release oils, dust, paint, waterproofing, and similar items. If required by manufacturer, apply conditioner to substrate by sprayer or roller to chalking or excessively absorptive surfaces.

C. Apply metal lath, attach with galvanized screws that penetrate a minimum of 1" into substrate. Apply 6 inches on center vertically and 16 inches on center horizontally.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions as applicable to each type of substrate required. Install bricks to specified pattern and mortar.

B. Metal Grid: Apply to substrate surface in the true level rows, interlock at every panel. Install such that panel does not extend 1/4 inch (6 mm) below the face of the brick.

1. Offset vertical grid joints and leave 1/4 inch (6 mm) between joints. Install for brick to extend past grid by 1/2 inch (13 mm) at grid ends.

2. Fasten grid system to a sound substrate or wall with a non-corrosive fastener; minimum penetration of substrate is 1 inch (25 mm). Concrete and masonry walls require fasteners and adhesive on rear of metal grid.

3. Install fasteners on an average of 3 per square foot (0.1 square meters) and at top and bottom courses vertically and a maximum of 16 inches (406 mm) on center horizontally.

C. Brick Placement:

1. Applications Requiring Corners:

a. Start with corner brick, or a corner brick at each corner if there are corners at both ends.
b. Install bricks adjusting vertical joints for fit or cut brick as required.

2. Applications that do not required corners:

a. Install bricks in direction of arrows as shown in manufacturer's literature.
b. Place adhesive on two rows of grid in the middle of wall.

c. Adjust vertical joints to fit area, 3/8 inch to 1/2 inch (9.5 mm to 13 mm), to fit wall space.
d. Cut end bricks as needed. Install bricks horizontally than vertically.
e. Draw a plumb vertical line every 48 inches (1219 mm) to help maintain spacing.
f. Joint size as indicated on drawings.

D. Mortar (used at joints and to enhance bonding between brick and metal back up0

1. Allow adhesive to fully cure before mortaring joints.

2. Use clean, cold water to mix mortar. Flush hoses regularly; especially during warm weather.

3. Slightly dampen bricks before mortaring; especially during hot weather.

4. Mix properly and test a sample area.

5. Do not apply mortar to brick panel system when the ambient outdoor temperature is below 36 degrees F (2.2 degrees C) unless temporary protection and heat can be provided for a minimum of 36 hours after installation.

6. Apply mortar into horizontal joints first, then vertical joints. Over fill joints with enough mortar to avoid leaving any voids. When mortar attains a firm consistency joints shall be tooled.

7. Use the joint tool supplied with the mortar kit to strike joints. Press the tool against the joint and strike joint to fill and seal mortar to edges of brick. Strike the vertical joints first than horizontal joints. Provide concave finish. Fill voids.

E. Sealer: Apply only after mortar joints are thoroughly cured. Allow a minimum of 2 weeks prior to application.

1. Seal exterior applications in accordance with manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. Arrange and pay for project inspection by Brick-It or its authorized representative to confirm warranty will be provided. Notify Architect 48 hours in advance of inspection.

3.5 CLEANING AND PROTECTION

A. Cleaning: As recommended by manufacturer. Do not begin cleaning until mortar joints are properly cured. Allow a minimum of 24 to 72 hours. Soak bricks and mortar joints before applying cleaner.

1. Thoroughly flush wall after cleaning.

2. Clean adjacent materials and surfaces of all foreign materials resulting from the work of this Section.

B. Protection

1. Protect installed materials from water impinging on the visible surface, chinking, sealants joints, and from behind.

2. Protect installed materials from dust, dirt, precipitation, freezing, damaged, spilled materials, and continuous high humidity until they are fully dry.

END OF SECTION

SECTION 044200 - EXTERIOR STONE CLADDING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the exterior stone cladding as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Granite base at building façade.
2. Anchors, ties, and other fastening devices as required to securely anchor in place all the stone.
3. Fitting and cutting of stone work as required for the proper completion of the work.
4. Accessories and hardware required for complete installation.
5. Protection of stone during transit, storage, erection and after installation. Cleaning of stone prior to acceptance.
6. Coordination and provision for and interfacing with adjoining construction.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit masonry – Section 042000.

C. Air Barrier – Section 072700.

D. Sheet Metal Flashing - Section 076200.

E. Joint Sealants - Section 079200, for sealing of stone-to-stone joints.

1.4 QUALITY ASSURANCE

A. Granite must conform to the minimum specification standards of the National Building Granite Quarries Association (NBGQA).

B. Granite shall meet the minimum physical requirements as specified in ASTM C 615 "Standard Specification for Granite Dimension Stone."

C. Mock-Up: Provide job installation site mock-up showing stone anchorage system engineered by Contractor, relationship to adjacent construction, joint treatment, weeps, related flashing and all other accessories required to show how stone cladding will go together on the structure. Refer to drawings for size of mock-up; remove mock-up when directed by the Architect.

1.5 SUBMITTALS

1.6 SUBMITTALS

A. Shop Drawings: Prior to construction of mock-up, submit shop drawings for the fabrication and installation of all work and associated components. Include:

1. Wall elevations at 1/4" scale, typical unit elevation at 1" scale.

2. Show details of all conditions for every member, joint, anchorage and provision for expansion and contraction and joint treatment.

3. Include coordination details for related and adjoining work, insert drawings and erection diagrams. Show relative layout for all adjacent walls, beams, columns and slabs, all correctly dimensioned.

4. Stone: Submit complete cutting and setting drawings to Architect for approval. Shop sizes, shapes, thicknesses, jointing, anchoring, connection with other work, typical and special anchoring details, supports, dimensions, setting numbers, and color range for each piece of stone. Clearly indicate dimensions for locating slots in stone and for locating inserts to be built into concrete and masonry. Do not fabricate any stone (except for samples) until shop drawings have been approved by the Architect. Shop drawings shall be based upon actual field measurements to determine exact dimension of each stone piece and anchorage required. Dimensions shown on shop drawings shall be actual field dimensions.

B. Provide structural calculations, prepared by a Professional Engineer licensed in State of New York, prepared in compliance with referenced documents and these specifications. Where specifications and code differ, the more stringent requirement shall govern. Calculations shall be legible and shall incorporate sufficient cross references to shop drawings to make the calculations readily understandable and reviewable. Calculations shall include the following information:

1. Analysis for all applicable loads on substrate.

2. Analysis for all applicable loads on anchors.

3. Analysis of stress in stone and required safety factors.

C. Allowable stresses for stone shall be based upon material properties required herewith and computed as follows:

Coefficient of Variation (Standard Deviation/Mean)	Modulus of Rupture	Safety Factor Required
0-5 percent	Mean	2.0
5-10 percent	Mean	2.5
10-15 percent	Mean	3.75
15-20 percent	Mean	5.0

D. Safety factors required at anchor locations shall be 2.0 times the values noted above for the allowable stresses in the field of the panel.

E. Calculation of allowable stresses on stone shall be based upon the minimum thickness (nominal thickness minus the thickness tolerance). Under no condition shall stone thickness be less than that indicated on the Drawings.

F. Review of calculations and shop drawings by the Architect will not relieve the Contractor of any responsibilities for providing a system within the required performance requirements. Calculations shall be signed and sealed by the Contractor's Engineer.

G. Manufacturer's Data

1. Submit copies of manufacturer's specifications and installation instructions for each stonework accessory required. Include data substantiating that materials comply with specified requirements. Indicate that installer has received copy of manufacturer's instructions.

2. Manufacturer's instructions for handling and storage at job site; installation and protection of stone. Indicate that erector of stonework has received a copy of each instruction.

H. Samples

1. Submit samples of all materials and finishes and details. Samples include standard submission samples, visual mock-up samples, sample slabs, production samples, and additional samples as described below.

2. Samples shall demonstrate the complete range of visual properties of the material and finish as specified in PART 2 – MATERIALS.

3. Samples shall represent the single exposed surface grain, i.e. head, rift or lift, as proposed by the Contractor and approved by the Architect.

4. Sample slabs shall be displayed at the quarry or the fabrication plant as selected by the Architects.

5. First Submission Sample Slabs: The first submission shall be taken from representative areas (e.g. top, middle or bottom) of each existing or proposed quarry work station required to provide Dimension Stone, and are to represent the proposed range of visual properties, including color, value (lightness/darkness), figuring, grain direction, dark inclusions, etc. Sample slabs shall be the full dimensions of the quarried blocks and finished as specified in PART 2 – MATERIALS.

6. Subsequent to the Architect's approval of the First Submission Sample Slabs, one identical set of control samples of the approved range shall be submitted for approval and provided to each of the following: the Owner, the Architect, and the General Contractor. The fabricator shall maintain an original sample set until completion of the Project.

7. Samples shall be the following sizes:

   a. Standard Submission Samples: 12 inches x 12 inches (5 copies).
   b. Sample Slabs
      1). Sample slabs shall be full quarried block dimension, job thickness, as described above.
      2). Sample slabs shall be from at least 10 different blocks.

8. Range Samples: Range samples shall be 60 inches x 60 inches x job thickness; each set to have at least 5 examples (from at least 5 different blocks) representing the approved range of color, graining, and tonality.

9. Additional Samples: The Contractor for the Work of this Section shall have available an adequate quantity of matching approved samples as in Item a. above, to be provided in order to enable the Architect to coordinate the construction and finishes of other trades.

1.7 FABRICATION AND ERECTION TOLERANCES

A. Tolerances are as follows:

1. Except as noted, all joints shall be 3/8".

2. Stone dimension tolerance shall be +0, -1/16" in both directions with 90 deg. angle for all corners.

3. Stone face dimension tolerance (flatness) shall be +0, -1/16" in all directions.

4. Stone thickness tolerance shall be -1/4", +1/4".

B. Variation From Plumb: For lines and surfaces of walls and arrises, do not exceed 1/8" in 20 ft. max. For external corners, expansion joints and other conspicuous lines, do not exceed 1/8" in any story or 20 ft. max.

C. Variation of Linear Building Line: For position shown in plan and related portion of grid lines, walls and partitions, do not exceed 1/8" in any bay or 30 ft. max.

D. Offset at Joints: Do not exceed plus or minus 1/32".

E. Slope, Splay, and Miter Cuts: Plus or minus 1.5 degrees.

F. Square Cuts: Plus or minus 1/16" per 3'-0".

1.8 PERFORMANCE REQUIREMENTS

A. Structural Requirements: The work, as erected, shall be designed to withstand a lateral force of 30 psf (or greater if required by Code) applied over field surface normal to face of stone. Deflection under this load shall be limited to L/360 or 3/8" whichever is less.

B. Provision for Thermal Movements

1. The work shall be designed to provide for such expansion and contraction of component material, as will be caused by a surface temperature ranging from -20 deg. F. to +180 deg. F., without causing buckling, stresses on glass, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance or other detrimental effects.

2. The amount of such movement that is accommodated in the Contractor's design and method of accommodating it shall be identified on Contractor's submittal drawings, and shall be accompanied by thermal calculations.

C. Provision for Movement of the Structure

1. The work will be designed to accommodate dead load and live load bending deflection and column shortening as follows:

    a. Anticipated interstory differential vertical movement: See drawings.
    b. Anticipated interstory differential lateral movement:
    c. All values are maximum values and include long term creep effects.

2. The above movements are net structural frame motions and not joint sizes

3. The amount of such movement that is accommodated in the Contractor's design shall be identified on the Contractor's submittal drawings.

D. Methods and fabrication and assembly (except as specified herein) shall be at the discretion of the Contractor provided that the visible architectural effect is not changed, the work of other Contractors is not affected and the strength qualities, as demonstrated by engineering calculations are not reduced.

E. Remedial measures, which may be necessary on the building, shall maintain standards of quality and durability and are subject to approval by the Architect.

F. Anchors

1. Adequate number and size of anchors shall be provided to satisfy the load requirements and design criteria.

G. Variations in Structure: The work shall be designed to accommodate variation in location of surrounding and supporting work, as defined as allowable variations in the work, as specified in other Sections of the project Specifications.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect stone during storage and construction against moisture, soiling, staining, and physical damage.

B. Handle stone to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.

C. Store stone on wood skids or pallets, covered with non-staining, waterproof membrane. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Protect stored stone from weather with waterproof, non-staining covers or enclosures, but allow air to circulate around stone.

D. Protect mortar materials and stonework accessories from weather, moisture, and contamination with foreign materials.

1.10 JOB CONDITIONS

A. Installer must review installation procedures and coordination with other work with Contractor and other subcontractors whose work will be affected by stonework.

1.11 PROTECTION

A. Protect adjacent surfaces from damage. Protect exposed surfaces of stone units from damage or defacement. Prevent materials used for installing work of this Section from staining or damaging the exposed surfaces of stone units or the exposed surfaces of the adjoining construction.

B. Protect all stonework from other materials that will cause staining or defacement. Stone subject to damage after setting shall be properly covered or protected.

C. No lumber or other material liable to stain or deface the stone shall be used.

1.12 WARRANTY

A. Unless stated otherwise in these specifications, warranty shall state that all work is in accordance with drawings and specifications, as amended by any changes thereto authorized by the Architect, free from defects in workmanship and weathertight for a period of five (5) years from the date of acceptance of the work by the Owner. Contractor shall agree to repair or replace defective workmanship during the warranty period at no additional cost to the Owner.

B. Contractor shall be responsible for damage to the building and furnishings occasioned by defective workmanship or damage as part of repairs to the stone cladding.

C. The warranty, the enforcement or lack of enforcement thereof, shall not deprive the Owner of other actions, rights, or remedies available to him. Warranty shall be in form approved by the Architect.

PART 2 PRODUCTS

2.1 STONE

A. Stone shall be granite with honed finish or as selected by Architect. Comply with ASTM C 615.

B. Visual Criteria for Stone: All examinations, selections, and approvals shall be for the purpose of achieving a final appearance of stone with greatest possible uniformity, and will be based upon the following criteria:

1. All stone shall be of sound stock and uniform texture, and shall be free from holes, seams, shakes, clay pockets, spalls, stains, starts, and other defects which would impair the strength, durability, and appearance of the work, as determined by the Architect.

2. Inherent variations characteristic of the stone and the quarry from which the stone is to be obtained shall be brought to the attention of the Architect at the time the samples are submitted for approval and shall be subject to approval of the Architect.

C. Fabrication, General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

2.2 ACCESSORY MATERIALS FOR STONEWORK

A. Mortar Materials

1. White Portland Cement: ASTM C 150, Type 1, non-staining. Cement shall in no case contain more than 0.03% by weight of soluble alkali (calculated as Na_2O). Submit mill certificates of cement and certified analysis from an approved testing laboratory.

2. Sand: ASTM C 144, except graded with 100% passing No. 16 sieve, non-staining.

3. Hydrated Lime: ASTM C 207, Type S.

4. Water: Potable, clear and free of deleterious materials which would impair the quality of the mortar.

5. For colored pointing mortar, provide integral, non-fading colorant made by Davis Colors or approved equal; color selected by the Architect.

B. Stone Support System(s): Furnish all anchors, fastening devices, supports, and the like fitting hardware as necessary to properly secure stone units. Types to be approved, of sizes and shapes to fit each particular support condition encountered. Metal components shall be stainless steel, Type 304, nonmagnetic.

1. Stainless Steel to be used for stone supports shall conform to the following:

a. Sheet, Bar and Plate: AISI Type 302/304 non-magnetic, conforming to ASTM A 167.
b. Fasteners, Anchor Bolts, Nuts and Washers: AISI Type 302/304 non-magnetic, ASTM A 167.
c. Shims: AISI type 302/304, non-magnetic.

C. Weeps: No. 341 plastic weep tubes, 1/4" O.D. made by Hohmann & Barnard or approved equal.

D. Flashing: 26 ga. ASTM A 666, Type 304 stainless steel.

2.3 MORTAR MIXES

A. Setting Mortar: Conform to ASTM C 270, Type N, Portland cement/lime mortar.

B. Mix cementitious materials, admixtures, and aggregate with the proper amount of water consistency which will result in a homogeneous, still and plastic mix.

C. Mix mortar in small batches by approved mechanical mixes. Monitor volume of materials per batch carefully.

D. Retempering of mortar will not be permitted, and mortar that has been allowed to stand more than one or two hours shall not be used. Mortar shall be mixed and kept tempered so that it will, at all times, contain as much water as it is able to carry.

PART 3 EXECUTION

3.1 EXAMINATION OF STRUCTURE

A. Examine all parts of the supporting structure and the conditions under which the stonework is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation of stonework until unsatisfactory conditions are corrected to permit proper installation of the work.

B. Review installation procedures and coordinate with other work, and with other contractors whose work will be affected by the stonework.

C. Advise General Contractor of requirements relating to his placement of any inserts which are to be used by this Contractor for anchoring and supporting of stonework.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Workmanship: All parts of the work shall be erected plumb and true, in proper alignment and relation to established lines and grades, and as shown on approved shop and/or erection drawings.

B. Do not use stone units with chips, cracks, voids, stains, or other defects which might be visible in the finished work. Patching or hiding defects in stone will not be permitted.

3.3 SETTING STONE

3.4 SETTING STONE

A. Setting Mortar: Conform to ASTM C-270 Type N, Portland cement/lime mortar.

B. Pointing Mortar

1. 1 part non-staining white cement with color ingredient

2. 6 parts clean selected white sand to be compatible with the colored cement; sand to pass No. 16 sieve

3. 1 part hydrated lime to make as still a mix as can be worked

4. Water as required

C. Mixing

1. Mix cementitious materials, admixtures, and aggregate with the proper amount of water consistency which will result in a homogeneous, still and plastic mix.

2. Mix mortar in small batches by approved mechanical mixes. Monitor volume of materials per batch carefully.

3. Retempering of mortar will not be permitted, and mortar that has been allowed to stand more than one or two hours shall not be used. Mortar shall be mixed and kept tempered so that it will, at all times, contain as much water as it is able to carry.

D. Anchors

1. A minimum of 2 anchors shall be required on all pieces up to 2 square feet in area.

2. A minimum of 4 anchors shall be required on all pieces up to 20 square feet in area.

3. A minimum of 2 additional anchors shall be required on each additional 10 square feet.

E. Set stone and install stone support systems in accordance with drawings and final shop drawings for stonework. Provide anchors, supports, fasteners, and other attachments shown, or necessary to secure stonework in place. Shim and adjust accessories as required for proper setting of stone. Completely fill holes, slots and other sinkages for anchors, dowels, fasteners, and supports with mortar during setting of stones.

F. Before setting in the wall, all stones shall be thoroughly cleaned on all exposed surfaces by washing with fiber brush and soap powder, followed by a thorough drenching with clear water.

G. All stone joint surfaces not thoroughly wet shall be drenched with clear water just prior to setting.

H. Every stone shall be set in full beds of mortar with all joints slushed full. All joints shall be 3/8" unless otherwise noted.

I. Lead or plastic setting pads shall be placed under heavy stones., in sufficient quantity to avoid squeezing mortar out. Heavy stones or projecting courses shall not be set until mortar in courses below has hardened sufficiently to avoid squeezing.

J. Joints shall be raked out 1" and pointed with pointing mortar. If sealant joints are noted, joint shall be raked out full depth to remove back-up rod and sealant per Section 079200.

K. Weep tubes shall be placed in joints where moisture may accumulate within the wall, such as at base of cavity, continuous angles, flashing, etc., or as shown on drawings. Space weeps 24" o.c. unless otherwise noted.

L. Projecting stones shall be securely propped or anchored until the wall above is set.

M. In cold weather, International Masonry Industry All-Weather Council recommendations for setting from 40 deg. F. to 20 deg. F. shall be followed, except that no additives shall be used in the setting mortar, and below 20 deg. F. all work shall be done in heated enclosures.

3.5 PROTECTION OF STONEWORK

A. Prevent materials used for installing work of this Section from staining or damaging the exposed surfaces of stone units or the exposed surfaces of the adjoining construction. Immediately remove mortar, grout, or other detrimental materials from exposed surfaces of stone or adjoining construction.

B. During installation, cover tops of walls and projections with waterproof sheeting at the end of each day's work. Cover partially completed stonework when construction is not in progress.

C. Protect all stonework from other materials that will cause staining or defacement. Stone subject to damage after setting shall be properly covered or protected.

1. Protect base of walls from rain-splashed mud and mortar splatter by covering spread on the ground and over the wall surface.

2. Lumber or other material liable to stain or deface the stone shall not be used in contact with stone.

D. Provide additional protection for finished work such as exposed edges, corners, and all other stone liable to physical injury or staining. Protection shall include but is not limited to non-staining approved coverings, and clean non-staining wood boxing. All fastenings or hold-back devices shall be stainless steel. Fastening to stone joints is prohibited.

E. At completion of construction work, remove all temporary protection installed as work of this Section.

F. After installation, protect stonework from damage during subsequent construction activities.

3.6 ADJUSTING, CLEANING, AND REPAIRING

A. Examine all work and repair all damage. Clean soiled or stained surfaces. In the event damage is irreparable, or soiled or stained surface cannot be cleaned, then remove and replace such items at no additional cost to Owner.

B. Remove and replace stonework of the following description:

1. Defective, broken, chipped, stained, or otherwise damaged stone units installed as work of this Section.

2. Unfilled or defective joint.

3. Stone masonry and joints not matching approved samples and mockups.

C. Replace in manner that results in stonework matching approved samples and mockups.

D. In-Progress Cleaning: Clean stonework as work progresses. Remove mortar fins and smears before tooling joints.

E. Final Cleaning: After setting mortar and, as applicable, mortar is thoroughly set and cured, clean stonework as follows:

1. After completion of any repair work, clean exposed surfaces of all stone surfaces and units installed as work of this Section with clean water and stiff fiber brushes until all dirt, stains, efflorescence, mortar, and other defacements are removed. Use cleaner and procedures recommended by stone quarry and stone fabricator and approved by Architect. Do not use wire brushes, metal scrapers or acids. Protect adjacent surfaces from damage during cleaning operations.

2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

3. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of each area or element of stonework.

END OF SECTION

SECTION 047200 - CAST STONE

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the cast stone as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Cast stone elements on building façade.
2. Mortar.
3. Anchors and accessories.
4. Joint filler.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Cold formed metal framing.

C. Joint Sealants - Section 079200.

1.4 QUALITY ASSURANCE

A. Qualifications of Workmen

1. For the actual cutting and placing of cast stone units, use only skilled journeyman masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
2. In acceptance or rejection of installed cast stone units, no allowance will be made for lack of skill on the part of workmen.

B. Manufacturer shall have a minimum of ten (10) years' experience in the manufacture of cast stone. Manufacturer's products must have previously been used on the exterior with satisfactory results. Manufacturer must have capability to produce cast stone on schedule and must be a member of the Cast Stone Institute.

C. Casting Tolerances: Maintain casting, bowing, warping and dimension tolerance within the following maximums:

1. Overall Dimension for Height and Width of Units: Plus zero of unit dimension to minus 3/32" for 10'-0" and over.

2. Twist, Bowing or Warping: Do not exceed length/360 or 1/8", whichever is greater.

3. Insert Locations: Place within plus or minus 1/8" in each direction.

4. Length of units shall not deviate by more than +/- 1/8" from approved dimensions.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 1364 Standard Specification for Architectural Cast Stone, except where more stringent standards are specified herein.

2. ASTM C 150 Specification for Portland Cement.

3. ASTM C 33 Specification for Concrete Aggregates

4. ASTM C 979 Specification for Coloring Pigments for Integrally Pigmented Concrete.

5. ASTM C 494 Specification for Concrete Admixtures

6. ASTM A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

7. ASTM C 1194 Test Method for Compressive Strength of Architectural Cast Stone.

8. ASTM C 1195 Test Method for Absorption of Architectural Cast Stone.

9. ASTM C 642 Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

10. ASTM C 39 Test Method for Compressive Strength of Concrete Cylinders.

11. ASTM D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

E. Testing: Test three specimens per 500 cubic feet at random from plant production in accordance with referenced standards.

F. Cold weather setting practices shall conform to the requirements specified in Section 042000.

1.5 SUBMITTALS

A. Submit samples of cast stone with documented independent testing laboratory reports to the Architect for approval.

B. Samples: Before any cast stone materials are delivered to the job site, submit twelve (12) inch long samples of each profile type cast stone unit required.

1. Submit 6" x 6" cast stone samples showing full range of colors and texture available.

C. Shop Drawings: Submit complete shop drawings, elevations in 1/4” scale of all cast stonework showing anchorage, type, location and spacing, joint fillers, mortar, and cast stone profiles, sizes, connections, location, type and size of reinforcing and adjacent construction.

1. The shop drawings shall show the setting mark of each stone and its location on the structure. The stone when delivered shall bear the same corresponding setting mark on an unexposed surface.

2. Shop drawings must show exact profiles for each piece.

3. Shop drawings shall be signed and sealed by a New York State Licensed Professional Engineer confirming cast stone anchorage and assemblies comply with New York City Building Code requirements.

D. Certification: Submit certification from an independent testing laboratory certifying to test results required under Article 1.4, Para. E. herein.

1.6 INSTALLATION MOCK-UP

A. As shown in construction drawings.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect cast stone and related materials before, during and after installation and to protect the installed work and materials of all other trades.

1. Stone shall be stored on skids off the ground and covered with plastic sheeting; all material in contact with stone shall be non-staining.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.8 WARRANTY

A. Warrant that the cast stone will not spall or show evidence of visible warping, cracking, or staining resulting from materials or workmanship by this trade for a period of ten (10) years, effective from date of substantial completion. Units showing such defects will be replaced and made good, together with any work of other trades damaged during removal of defective precast units, at no expense to the Owner.

PART 2 PRODUCTS

2.1 CAST STONE COLOR AND FINISH

A. Cast stone used in this work shall match color and texture of samples approved by the Architect.

B. Exposed surfaces, unless otherwise specified, shall exhibit a typically fine-grained texture similar to natural stone. No bug holes will be permitted and all facing material shall be mixed in a muller mixer.

C. The samples shall be approved by the Architect before the manufacturer shall be required to proceed with the work.

2.2 MANUFACTURER

A. Cast stone used in this work shall be manufactured by Precast Stones NY Corp., 3275 Grace Avenue, Bronx, NY 10469, wilsonuc@aol.com, or comparable product by Dura Art Stone Co., Mohan's Precast USA, or approved equal and conform to the following properties:

1. Compressive Strength, ASTM C 1194: 6500 psi min. for products at 28 days.

2. Absorption, ASTM C 1195 or ASTM C 642: 6% max. for products at 28 days.

3. Cumulative Percent Weight Loss (CPWL) shall be less than 5% after 300 freeze/thaw cycles when tested in accordance with ASTM C 1364.

4. Air Content: ASTM C 173 or C 231, for wet cast product only shall be 4-8%. Air entrainment is not required for dry cast products.

5. Linear Shrinkage - ASTM C 426: Shrinkage shall not exceed 0.065%.

6. Color Variation

   a. Must match color and finish of approved sample when viewed in direct daylight at a 5 foot distance.
   b. ASTM color variation allowed - 2% hue; 6% lightness, chrome and hue combined.

2.3 MATERIALS

A. Cement shall be Portland Type I white, meeting ASTM C 150.

B. Fine aggregate shall be carefully graded and washed natural sands, or manufactured granite, marble, quartz or limestone sands meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture.

C. Coarse aggregate shall be carefully graded and washed natural gravel, or crushed graded stone such as granite, marble quartz, limestone or other durable stone meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture.

D. Coloring: All colors added shall be inorganic (natural or synthetic) iron oxide pigments meeting ASTM C 979 excluding the use of a cement grade of carbon black pigment, and shall be guaranteed by the manufacturer to be light fast and lime proof. The amount of pigment shall not exceed ten (10) percent by weight of the cement used. Colorant shall be manufactured by Davis Colors or approved equal.

E. Cast stone shall be reinforced with new billet steel reinforcing bars meeting ASTM A 615, grade 60, when necessary for safe handling, setting and structural stress, and the size of the reinforcing shall be as shown on approved shop drawings. If the surfaces are to be exposed to the weather, the reinforcement shall be galvanized or epoxy coated when covered with less than two (2) inches of material for bars larger than 5/8 inch and 1-1/2 inches for bars 5/8 inch or smaller. The material covering in all cases shall be at least twice the diameter of the bars. Stone shall be fully reinforced to take all stresses including handling, temperature changes and structural stress.

F. All anchors, dowels and other anchoring devices shall be furnished by the stone setter as shown on approved shop drawings using building stone anchors fabricated of Stainless Steel Type 304.

1. Anchors shall allow for wracking of the structure (seismic) without stressing the cast stone units.

2.4 FABRICATION

A. Cast stone, after being made, shall be cured as noted below in Article 2.5.

B. Cast stone shall be "dry cast" or "wet cast" (depending upon selected finish) to produce sharp arrises to match profiles on approved shop drawings. Provide stone with sinkages to receive anchors.

C. Cast stone for copings shall be fabricated to largest practical length, as shown on approved shop drawings.

D. Acid etch exposed surfaces as required to remove cement film prior to packaging and shipment. Sandblasting or chemical retardation finishing is not permitted.

2.5 CURING

A. Cure units in a warm curing chamber approximately 100 deg. F. at 95% relative humidity for approximately 12 hours, or cure in a 95% moist environment at a minimum 70 deg. F. for 16 hours after casting. Additional yard curing at 95% relative humidity shall be 350 degree days (i.e. 7 days at 50 deg. F. or 5 days at 70 deg. F. prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

2.6 ACCESSORIES

A. Stone Support System(s) engineered by contractor: Furnish all anchors, fastening devices, supports, and the like fitting hardware as necessary to properly secure stone units. Types to be approved, of sizes and shapes to fit each particular support condition encountered. Metal components shall be stainless steel, Type 304, nonmagnetic.

1. Stainless Steel to be used for stone supports shall conform to the following:

a. Sheet, Bar and Plate: AISI Type 302/304 non-magnetic, conforming to ASTM A 167.
b. Fasteners, Anchor Bolts, Nuts and Washers: AISI Type 302/304 non-magnetic, ASTM A 167.
c. Shims: AISI type 302/304, non-magnetic.

B. Weeps: No. 341 plastic weep tubes, 1/4" O.D. made by Hohmann & Barnard or approved equal.

C. Flashing: 26 ga. ASTM A 666, Type 304 stainless steel.

D. Mortar for setting of cast stone sections shall conform to ASTM C 270, Type N, with not more than 1/2 part lime per part of white non-staining Portland cement.

E. Joint Filler: Fill all joints with exposed tops with "Emseal" Greyflex Expanding Foam Sealant as manufactured by Emseal, Inc. or approved equal. Material shall be designed for compression in joint twenty-five (25) percent of its original width, depth of filler as per manufacturer's standard. Joint filler shall be recessed 3/4" from finished surface.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cast stone is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 JOINTING

A. Joint Size: 3/8", unless otherwise noted.

B. Joint Material

1. Use a full bed of mortar at all bed joints, where indicated.

2. Flush vertical joints full with mortar.

3. Leave all joints with exposed tops open for sealant.

C. Location of Joints: As shown on approved shop drawings.

3.4 SETTING

3.5 SETTING STONE

A. Setting Mortar: Conform to ASTM C-270 Type N, Portland cement/lime mortar.

B. Pointing Mortar

1. 1 part non-staining white cement with color ingredient

2. 6 parts clean selected white sand to be compatible with the colored cement; sand to pass No. 16 sieve

3. 1 part hydrated lime to make as still a mix as can be worked

4. Water as required

C. Mixing

1. Mix cementitious materials, admixtures, and aggregate with the proper amount of water consistency which will result in a homogeneous, still and plastic mix.

2. Mix mortar in small batches by approved mechanical mixes. Monitor volume of materials per batch carefully.

3. Retempering of mortar will not be permitted, and mortar that has been allowed to stand more than one or two hours shall not be used. Mortar shall be mixed and kept tempered so that it will, at all times, contain as much water as it is able to carry.

D. Anchors

1. A minimum of 2 anchors shall be required on all pieces up to 2 square feet in area.

2. A minimum of 4 anchors shall be required on all pieces up to 20 square feet in area.

3. A minimum of 2 additional anchors shall be required on each additional 10 square feet.

E. Set stone and install stone support systems in accordance with drawings and final shop drawings for stonework. Provide anchors, supports, fasteners, and other attachments shown, or necessary to secure stonework in place. Shim and adjust accessories as required for proper setting of stone. Completely fill holes, slots and other sinkages for anchors, dowels, fasteners, and supports with mortar during setting of stones.

F. Before setting in the wall, all stones shall be thoroughly cleaned on all exposed surfaces by washing with fiber brush and soap powder, followed by a thorough drenching with clear water.

G. All stone joint surfaces not thoroughly wet shall be drenched with clear water just prior to setting.

H. Every stone shall be set in full beds of mortar with all joints slushed full. All joints shall be 3/8” unless otherwise noted.

I. Lead or plastic setting pads shall be placed under heavy stones., in sufficient quantity to avoid squeezing mortar out. Heavy stones or projecting courses shall not be set until mortar in courses below has hardened sufficiently to avoid squeezing.

J. Joints shall be raked out 1” and pointed with pointing mortar. If sealant joints are noted, joint shall be raked out full depth to remove back-up rod and sealant per Section 079200.

K. Weep tubes shall be placed in joints where moisture may accumulate within the wall, such as at base of cavity, continuous angles, flashing, etc., or as shown on drawings. Space weeps 24” o.c. unless otherwise noted.

L. Projecting stones shall be securely propped or anchored until the wall above is set.

M. In cold weather, International Masonry Industry All-Weather Council recommendations for setting from 40 deg. F. to 20 deg. F. shall be followed, except that no additives shall be used in the setting mortar, and below 20 deg. F. all work shall be done in heated enclosures.

N. All joints with exposed tops shall be filled with joint filler specified herein recessed 3/4" from stone surface; balance of joint shall be filled with back-up rod and sealant by Section 079200.

3.6 PATCHING

A. The repair of chipped or damaged cast stone shall be done only by mechanics skilled in this class of work, with materials furnished by the manufacturer and according to his direction.

B. Patching will not be permitted on copings and any other piece which can be removed and replaced without undue difficulty. Replace such pieces which are chipped or damaged with identical new pieces. Reseal and/or repoint to remove any evidence of replacement.

C. Cast stone shall show no obvious repairs or imperfections other than minimal color variations when viewed with the unaided eye under good typical lighting at a ten (10) foot distance.

3.7 CLEANING

A. Before pointing, the face of all cast stone shall be scrubbed with a fiber brush, using soap powder and water and shall then be rinsed thoroughly with clean running water. Any mortar on the face of the cast stone shall be removed. No acids or prepared cleaners shall be used without the approval of the cast stone manufacturer.

3.8 POINTING

A. When ready for tuck pointing, the mortar joints shall be dampened and raked back 3/4" for pointing. Pointing shall form a slight concave profile. No pointing shall be done in freezing weather nor in locations exposed to hot sun unless properly protected. Pointing mortar shall be composed of one (1) part non-staining cement (ASTM C 91), one (1) part hydrate lime (ASTM C 207, Type S) and four (4) parts of clean, washed sand (ASTM C 144). Coloring pigments shall be added as specified in Section 042000 for face brick construction. The Architect shall approve color of pointing mortar before proceeding with pointing.

3.9 PROTECTION

A. All projecting cast stone pieces shall be fully protected when installed against damage of any kind. Any piece damaged shall be replaced at no additional cost.

3.10 INSPECTION AND ADJUSTMENT

A. Upon completion of the work, make a thorough inspection of all installed cast stone and verify that all units and joints have been installed in accordance with the provisions of this Section; make all necessary adjustments.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through the deck.
2. Section 055000 "Miscellaneous Metal" for steel lintels and shelf angles not attached to the structural steel frame and other steel items not defined as structural steel.
3. Section 099000 "Painting and Finishing"

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6 with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system, and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct a conference at the Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Galvanized-steel primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguish between shop and field welds, and show the size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate the type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the state of New York.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the Installer, fabricator, shop-painting applicators, and testing agency.

B. Welding certificates.

C. Mill test reports for structural-steel materials, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.

3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

E. Survey of existing conditions.

F. Source quality-control reports.

G. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1, Endorsement P2, Endorsement P3 or SSPC-QP 3.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off-ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on the structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and sealing containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies, and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by the fabricator's qualified professional engineer licensed in the state of New York.

a. Use Allowable Stress Design; data are given at the service-load level.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36

C. Bar and Miscellaneous Steel: ASTM A36

D. Plate: ASTM A572, Grade 50

E. Hollow Structural Sections: ASTM A500, Grade C and ASTM A1085 structural tubing.

F. Steel Pipe: ASTM A53, Grade B.

G. Steel Forgings: ASTM A668.

H. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with a plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with a plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined

ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with a plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy hex carbon steel.
3. Plate Washers: ASTM A36 carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Plain

B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

1. Nuts: ASTM A563 heavy hex carbon steel.
2. Plate Washers: ASTM A36 carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

C. Threaded Rods: ASTM A36.

1. Nuts: ASTM A63 heavy hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Plain.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 SHRINKAGE-RESISTANT GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, metallic aggregate grout, mixed with water to a consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to a consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in the shop to the greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to the greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for a type of bolt and type of joint specified.

1. Joint Type: Snug tightened, Pretensioned, or Slip critical.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanized lintels, shelf angles, and welded door frames attached to structural steel frame and located in exterior walls.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at the testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with a certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. A clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to the top of the base plate.
3. Snug-tightened anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with the edge of the plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect the grout and allow to cure. Comply with the manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of the complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of the structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for the difference between the temperature at the time of erection and the mean temperature when the structure is completed and in service.

E. Only splice members were indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes must be enlarged to admit bolts only after approval from the Engineer.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: As noted on the drawings.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by the manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1 and the manufacturer's written instructions.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where the primer is damaged or missing, and paint with the same material as used for shop paint to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: The owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify welding materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

   a. Power-actuated mechanical fasteners.
   b. Acoustical roof deck.

2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel and testing agency.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1.
2. AWS D1.3.

B. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-75 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ROOF DECK

A. Roof deck shall be manufactured by one of the following (or other equivalent as approved by the architect and engineer of record):
1. United Steel Deck (manufactured by Canam)
2. Vulcraft

B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 40 zinc coating.
2. Deck Profile: As indicated
3. Profile Depth: 1-1/2 inches
4. Span Condition: As indicated
5. Side Laps: Overlapped

2.3 COMPOSITE FLOOR DECK

A. Floor decks shall be manufactured by one of the following (or other equivalent as approved by the architect and engineer of record):
1. United Steel Deck (manufactured by Canam)
2. Vulcraft

B. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 40 zinc coating.
2. Profile Depth: 2 inches
3. Span Condition: As indicated

2.4 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

H. Galvanizing Repair Paint: ASTM A780 SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions 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, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 3/4 inch nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in Zone 1 and 6 inches apart in Zones 2 and 3, based on roof-area definitions in FM Global Loss Prevention Data Sheet 1-28**.**
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing:
   a. Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780 and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

    a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the cold-formed metal framing as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. "C" shaped steel studs for exterior non-load bearing wall frame construction.
2. "C" shaped steel joists.
3. Anchors and accessories.
4. Gypsum sheathing.
5. Field inspection.
6. Engineering of the exterior wall framing as noted in the drawings.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Cast Stone – Section 047200.

C. Structural Steel - Section 051200.

D. Thermal Insulation - Section 072100.

E. Vapor-Permeable Air Barrier Liquid Membrane - Section 072700.

F. Insulated Metal Wall Panels – Section 074213.19.

G. Interior steel stud construction - Section 092900.

1.4 QUALITY ASSURANCE

A. Component Design: Compute structural properties of studs in accordance with AISI "North American Specification for the Design of Cold Formed Steel Structural Members."

B. Fire-Rated Assemblies: Where framing units are indicated to be components of fire-resistance rated assemblies, provide cold formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction. Products used in the assembly shall carry a classification label from an approved testing and inspection agency.

C. Qualifications

1. Manufacturer's Qualifications: Minimum five years' experience in producing products of the type specified.

2. Installer's Qualifications: Minimum three years' experience in installation of the type of product specified.

3. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M "Structural Welding Code - Steel" and AWS DL3 "Structural Welding Code – Sheet Steel."

D. Pre-Installation Meeting

1. Convene meeting at project site within one week of scheduled start of installation with representatives of the following in attendance: Owner, Architect, General Contractor, and metal framing subcontractor.

2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.

3. Keep minutes of meeting, including responsibilities of various parties and deviations from specifications and installation instructions. Distribute minutes to attendees within 72 hours.

E. Comply with the following standards:

1. American Iron and Steel Institute (AISI):

a. "North American Specification for the Design of Cold-Formed Steel Structural Members," latest edition.
b. "Standard for Cold-Formed Steel Framing General Provisions."

2. American Welding Society (AWS):

a. Structural Welding Code (D1.1).
b. Specifications for Welding Sheet Steel in Structures (E1.3).

3. ASTM:

a. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coted (Galvannealed) by the Hot-Dip Process.
b. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
c. ASTM A 924 - Standard Requirements for Sheet Steel, Metallic-Coated by the Hot-Dipped Process.
d. ASTM C 955 – Standard Specification for Cold-Formed Structural Framing Members.
e. ASTM A 1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Non-Metallic-Coated for Cold-Formed Framing Members.
f. ASTM C 1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
g. ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

F. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.5 SUBMITTALS

A. Product Data: For information only, submit copies of manufacturer's product information and installation instructions for each item of cold-formed framing and accessories.

B. Shop Drawings

1. Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data. Include placing drawings for framing members showing size and gauge designations, number, type, location and spacing. Indicate supplemental bracing, splices, window and door headers accessories and details as may be required for proper installation.

2. If the Contractor elects to prefabricate framing members into panels for erection, he shall submit shop drawings of such panels at suitable scale showing all dimensions, components, and methods of fastening and support.

C. For fasteners, submit product data sheet and samples.

D. Engineering Data

1. Submit Engineering Data drawings to the Architect for review. The Contractor is responsible for the structural design and supports for the cold-formed metal frame and must show his proposed system and how the Performance Criteria noted below is accommodated on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New York and shall be signed and sealed by this Engineer.

E. Quality Assurance Submittals: Submit the following:

1. Qualifications: Proof of manufacturer and installer qualifications.

a. Member in good standing of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance.
b. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.

2. Structural design calculations.

3. Certificates

a. Submit mill certificates by framing member/accessory manufacturer certifying compliance with material requirements.
b. Welder certificates.

4. Manufacturer's installation instructions for framing members and framing accessories.

1.6 PERFORMANCE CRITERIA

A. Cold-formed metal framing system shall be designed, fabricated, and installed to withstand a suction and pressure load per ASCE-7 (or greater if required by Code) with a maximum deflection of L/360 with metal panels and L/720 with cast stone.

1. For insulated metal panels, provide minimum 16-gauge studs, unless greater required by performance requirements above.

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100 and AISI S200 and ASTM C955, Section 8.

C. Design system to accommodate vertical deflection of structural building frame, live loading, seasonal and day/night temperature ranges and construction tolerances.

D. Comply with prevailing Code requirements for seismic connections and loads.

1.7 PRODUCT DELIVERY AND STORAGE

A. Protect metal framing units from rusting and damage. Deliver to one project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off the ground in a dry ventilated space or protect with suitable waterproof coverings. Conform to storage and handling requirements of AISI "Code of Standard Practice."

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide cold-formed steel framing manufactured by Marino/Ware, Superior Steel Studs, Clark Dietrich Building Systems, Super Stud Building Products, or approved equal.

2.2 METAL FRAMING, GENERAL

A. System Components: With each type of metal framing required, provide manufacturer's standard steel runners, (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories, as recommended by manufacturer for the applications indicated, as needed to provide a complete metal framing system.

2.3 MATERIALS

A. Steel Sheet for Studs and Tracks: ASTM A 1003 Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.

2. Coating: G90 galvanized coating.

B. Steel Sheet for Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.

2. Coating G90 galvanized coating.

2.4 FRAMING MEMBERS

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges; thickness and grade as required by structural performance.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths compatible with studs, un-punched, with un-stiffened flanges; thickness and grade as required by structural performance.

2.5 FRAMING ACCESSORIES

A. Stamp manufacturer's name on each accessory item.

B. Provide screws with accessories designated for screw attachment.

C. Connector Devices

1. Vertical Deflection Clips: "VertiClip," including step bushings, as manufactured by The Steel Network Inc. (919) 845-1025 or approved equal. Rigid attachments to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement. 68 mils minimum thickness, size as required by structural design calculations.

2. Rigid Clip Angles: "StiffClip" as manufactured by The Steel Network Inc., or approved equal, size as required by structural design calculations. Rigid attachment to structure and stud web.

D. Bridging

1. Cold Rolled Channel: 1-1/2" by ½" by 56 mil thick.

a. Bridging Clip: "BridgeClip" as manufactured by The Steel Network Inc. or approved equal. Provide attachment through stud punch-out clamping onto stud web and wrapping around bridging channel. Provide holes for screw attachment to stud web and channel.

2. Flat Strap: Width and thickness as required by structural design calculations. Rigid attachment to stud flange.

3. Solid Bridging: Channel shaped bridging with lipped flanges and integral formed clips. Screw attachment to stud. 33 mils minimum thickness, size as required by structural design calculations.

4. Bridging and accessories shall be hot dip zinc coated per ASTM A 153.

E. Header for Window and Door Openings: Provide "ProX Header" system made by Brady Innovations LLC, or approved equal complete with all accessories including clips and accessories; finish and gauge to match studs.

2.6 FASTENERS

A. Screws: Corrosion resistant coated, self-drilling, pan or hex washer head. Provide screw type and size as required by structural design calculations.

B. Anchor Bolts and Studs: ASTM A 307, Grade A, carbon steel, with hex-head carbon steel nuts and flat steel washers. Hot-dip zinc coated in accordance with ASTM A 153. Provide bolt or stud type and size as required by structural design calculations.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

2.7 GALVANIZING TOUCH-UP

A. For touching up damaged galvanized surfaces after erection, provide "Silver Galv" made by Z.R.C. Worldwide. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.8 GYPSUM SHEATHING AND RELATED ACCESSORIES

A. Gypsum Sheathing: 5/8" thick "Dens-Glass Fireguard," Type X, made by Georgia Pacific, "Securock Glass-Mat Sheathing" made by U.S. Gypsum Co., "Gold Bond EXP Extended Exposure Sheathing" made by National Gypsum Co., "Weather Defense" made by Lafarge/Continental, or approved equal, meeting ASTM C 1177, Type X.

B. Fasteners: 1-1/4" Type S-12 screws "Climaseal" finish.

C. Joint Treatment: Provide a one-part high performance sealant conforming to ASTM C 920, Type S, Grade NS, Class 25 meeting with the approval of the air/vapor barrier manufacturer for compatibility; see Section 072700 for description. Apply a 3/8" bead of sealant to the joint and trowel flat. Apply enough of the same material to each fastener to cover completely when trowelled flat.

2.9 FABRICATION

A. Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion in any members in the assembly.

B. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting or screw fasteners, as standard with manufacturer.

C. Wire tying of framing components is not permitted.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cold-formed metal framing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Methods of construction shall be piece by piece.

B. Connections shall be accomplished with self-drilling screws or welding so that the connection meets or exceeds the design loads required at that connection.

C. Studs shall be installed seated squarely (within 1/16") against the web portion of the top and bottom tracks. Tracks shall rest on a continuous, uniform bearing surface.

D. Cutting of steel framing members may be accomplished with a saw or shear. Torch cutting of loaded members is not permitted. Cutting of loaded members is not permitted unless under supervision of the project architect or engineer.

E. Temporary bracing shall be provided and left in place until work is permanently stabilized.

F. Bridging shall be of size and type shown on the approved shop drawings and as called for in the engineering calculations.

G. Install headers in all openings that are larger than the stud spacing in that wall. Form headers as shown on the drawings.

H. Insulation meeting the requirements of Section 072100 shall be placed in all jamb and header type conditions that will be inaccessible after their installation into the wall.

I. Provide jack studs to support each end of headers. These studs shall be securely connected to the header and must seat squarely in the lower track of the wall, and be properly attached to it.

J. If, by design, a header is low in the wall, the less than full-height studs (cripples) that occur over the header shall be designed to carry all imposed loads.

K. Wall track shall not be used support any load unless specifically designed for that purpose.

L. All axially loaded members shall be aligned vertically, to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections or alternate provisions for load transfer may be made.

M. Holes that are field cut into steel framing members shall be within the limitation of the product and its design. Provide reinforcement where holes are cut through load bearing members in accordance with manufacturer's recommendations and as approved by the Architect or Engineer.

N. Touch up all steel bared by welding using touch-up coating specified herein.

O. Studs shall be spaced to suit the design requirements and limitations of collateral facing materials.

P. Care should be taken to allow for additional studs at intersections, corners, doors, windows, control joints, etc., and as called for in the shop drawings or design calculations.

Q. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

R. Provide for structure movement, expansion shall be allowed where indicated and necessary by design or code requirements.

S. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

T. Install horizontal bridging in stud system, spaced (vertical distance) at not more than 48 inches on center. Fasten at each intersection.

U. Splicing of axially loaded members or floor joists shall not be permitted.

V. Wire tying of members is not permitted.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Fasten sheathing to exterior of each stud with specified fasteners spaced 3/8" from ends and edges and approx. 8" o.c. at each stud. Install fasteners in accordance with manufacturer's recommendations using 2500-RPM maximum screw gun. Sheathing board shall be installed horizontally. Apply sealant between joints and trowel flush; and apply sealant around sheathing perimeter and at interface with other materials. Cover fastener heads with sealant and trowel flush.

B. Refer to Section 072700 for vapor permeable air barrier description.

END OF SECTION

SECTION 055000 - MISCELLANEOUS METALS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the miscellaneous metal work as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Rough hardware.
2. Vertical steel ladders.
3. Steel pipe handrails and railings, including at roof dunnage.
4. Loose bearing and leveling plates.
5. Loose steel lintels.
6. Light steel framing and supports not included as part of work of other trades.
7. Steel gratings and frames, including hot dip galvanized grating platform.
8. Steel plate covers and frames.
9. Stainless steel bar enclosure at holding cell – See A.820.
10. Adjustable roof access prefabricated metal steps/platform.
11. Structural steel door frames at service doors.
12. Cast thresholds.
13. Elevator divider beams, guide rail beams and elevator pit hold down beams.
14. Steel dunnage beams.
15. Steel bollards.
16. Roof dunnage.
17. Miscellaneous steel trim, corner guards, angle guards and channels.
18. Countertop supports.
19. Trench drains.
20. Steel garage wall shelf.

21. Masonry support steel.

22. Sleeves in concrete walls and slabs.

23. Steel framing, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on drawings or as required to complete each item of work of this Section.

24. Prime painting, touch-up painting, galvanizing and separation of dissimilar metals for work of this Section.

25. Cutting, fitting, drilling and tapping work of this Section to accommodate work of other Sections and of concrete, masonry or other materials as required for attaching and installing work of this Section.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Steel Pan Stairs - Section 055113.

C. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

C. Reference Standards: The work is subject to requirements of applicable portions of the following standards:

1. "Manual of Steel Construction," American Institute of Steel Construction.

2. AWS D1-1 "Structural Welding Code," American Welding Society.

3. SSPC SP-3 "Surface Preparation Specification No. 3, Power Tool Cleaning," Steel Structures Painting Council.

4. SSPC PA-1 "Painting Application Specification," Steel Structures Painting Council.

5. "Handbook on Bolt, Nut and Rivet Standards," Industrial Fasteners Institute.

D. Steel Materials: For steel to be hot dip-galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.

E. Engage the services of a galvanizer who has demonstrated a minimum of five (5) years' experience in the successful performance of the processes outlined in this specification in the facility where the work is to be done and who will apply the galvanizing and coatings within the same facility as outlined herein. The Architect has the right to inspect and approve or reject the galvanizer/galvanizing facility.

F. The galvanizer/galvanizing facility must have an ongoing Quality Control/Quality Assurance program which has been in effect for a minimum of five years and shall provide the Architect with process and final inspection documentation. The galvanizer/galvanizing facility must have an on-premise testing facility capable of measuring the chemical and metallurgical composition of the galvanizing bath and pickling tanks.

G. Inspection and testing of hot-dip galvanized coating shall be done under the guidelines provided in the American Hot-Dip Galvanizers Association (AGA) publication "Inspection of Products Hot-Dip Galvanized After Fabrication."

1.5 PERFORMANCE STANDARDS

A. Railings shall be designed to resist loads per New York State Building Code.

1.6 SUBMITTALS

A. Manufacturer's Literature: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.

B. Shop Drawings: Shop drawings for the fabrication and erection of all assemblies of miscellaneous iron work which are not completely shown by manufacturer's data sheets. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.

C. Engineering Data

1. Before any ladders or railings are fabricated, submit engineering data drawings to the Architect for review indicating how performance standards specified here shall be met. The Contractor is responsible for the structural design and supports for these systems and must show his proposed systems on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New York and shall be signed and sealed by this Engineer.

D. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld, weld and tack weld are not acceptable.

E. Certification: For items to be hot-dip galvanized, identify each item galvanized and to show compliance of application. The Certificate shall be signed by the galvanizer and shall contain a detailed description of the material processed and the ASTM standard used for the coating and, the weight of the coating. In addition, and as attachment to Certification, submit reports of testing and inspections indicating compliance with the provisions of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

2. Steel Plates, Shapes and Bars: ASTM A 36.

3. Steel Bar Grating: ASTM A 1011 or ASTM A 36.

4. Steel Tubing: Cold formed, ASTM A 500; or hot rolled, ASTM A 501.

5. Structural Steel Sheet: Hot rolled, ASTM A 1011; or cold rolled, ASTM A 1008, Class 1; of grade required for design loading.

6. Galvanized Structural Steel Sheet: ASTM A 924, of grade required for design loading. Coating designation G90.

7. Steel Pipe: ASTM A 53, type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.

8. Gray Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

9. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.

10. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

11. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.

12. Stainless Steel: Per Section 057300.

B. Grout: Non-shrink, non-metallic grout conforming to the requirements of Section 033000.

C. Fasteners

1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

2. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

3. Anchor Bolts: ASTM F 1554, Grade 36.

4. Lag Bolts: ASME B18.2.1.

5. Machine Screws: ASME B18.6.3.

6. Plain Washers: Round, carbon steel, ASME B18.22.1.

7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

8. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.

9. Lock Washers: Helical spring type carbon steel, ASME B18.21.1.

D. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

1. If steel is to receive high performance coating as noted in Section 099000, shop prime using primer noted in Section 099000.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Galvanizing Repair Coating: For touching up galvanized surfaces after erection, provide repair coating that is V.O.C. compliant, equal to "Silver Galv" made by Z.R.C. Worldwide or approved equal. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.2 PRIME PAINTING

A. Scope: All ferrous metal (except galvanized steel) shall be cleaned and shop painted with one coat of specified ferrous metal primer. No shop prime paint required on galvanized steel or aluminum work.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

1. Steel to get high performance coating as noted in Section 099000 shall be cleaned as per SSPC SP.6 "Commercial Blast Cleaning."

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

2.3 GALVANIZING

A. Scope: All ferrous metal exposed to the weather, and all ferrous metals indicated on drawings or in specifications to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication as provided by Duncan Galvanizing or approved equal.

B. Avoid fabrication techniques that could cause distortion or embrittlement of steel items to be hot-dip galvanized. Fabricator shall consult with hot-dip galvanizer regarding potential warpage problems or handling problems during the galvanizing process that may require adjustment of fabrication techniques or design before finalizing shop drawings and beginning of fabrication.

C. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.

D. Application: Hot-dip galvanizing shall conform to the following:

1. ASTM A 143: Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.

2. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM A 153: Galvanized Coating on Iron and Steel Hardware - Table 1.

4. ASTM A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

5. ASTM A 385: Practice for Providing High Quality Zinc Coatings.

6. ASTM A 924: Galvanized Coating on Steel Sheets.

7. Minimum weight of galvanized coating shall be two (2) oz. per square foot of surface.

E. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

F. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.

G. To minimize surface imperfection (e.g.: flux inclusions), material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.

H. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.

I. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Where this does not occur, piece shall be rejected and replaced to the acceptance of the Architect.

2.4 PROTECTIVE COATINGS

A. Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one coat of specified bituminous paint,

which shall be in addition to the specified shop prime paint. Mask off those surfaces not required to receive protective coating.

2.5 WORKMANSHIP

A. General

1. Miscellaneous metal work shall be fabricated by an experienced fabricator or manufacturer and installed by an experienced tradesman.

2. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings and specifications, approved shop drawings, and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected.

3. All work shall be accurately and neatly fabricated, assembled and erected.

B. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Shop assemble work in largest practical sizes to minimize field work. It is the responsibility of the miscellaneous metal subcontractor to assure himself that the shop-fabricated miscellaneous metal items will properly fit the field condition. In the event that shop-fabricated miscellaneous metal items do not fit the field condition, the item shall be returned to the shop for correction.

C. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

D. Holes: Drill or cleanly punch holes; do not burn.

E. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Architect.

1. Welding

a. Shall be in accordance with AWS D1.1 Structural Welding Code of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.
b. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
c. All welds on or behind surfaces which will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.

2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.

F. Operating Mechanism: Operating devices (i.e. pivots, hinges, etc.) mechanism and hardware used in connection with this work shall be fabricated, assembled, installed and adjusted after installation so that they will operate smoothly, freely, noiselessly and without excessive friction.

G. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items specified under this Section of the Specifications to be built into concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

H. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

I. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

J. Exposed Work

1. In addition to requirements specified herein and shown on drawings, all surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs, and other defects which mar appearance of finished work.

2. Metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.

3. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

K. Preparation for Hot-Dip Galvanizing: Fabricator shall correctly prepare assemblies for galvanizing in consultation with galvanizer and in accordance with applicable Reference Standards and applicable AGA publications for the "Design of Products to be Hot-Dip galvanized After Fabrication." Preparation shall include but not be limited to the following:

1. Remove welding flux.

2. Drill appropriate vent holes and provide for drainage in inconspicuous locations of hollow sections and semi-enclosed elements. After galvanizing, plug vent holes with shaped lead and grind smooth.

2.6 MISCELLANEOUS METALS ITEMS

A. Rough Hardware

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood connections; elsewhere, furnish steel washers.

B. Ladders: Vertical steel ladders shall be eighteen (18) inches wide with 3/4" diameter non-slip steel rungs spaced twelve (12) inches o.c. Stringers shall be 3/8" thick by 2-1/2" wide steel bars; rungs welded to bars. Attach ladders to walls six (6) inches from top and bottom and maximum thirty-six (36) inches o.c. from these points. At the roof, gooseneck the rails back to the structure to provide secure ladder access.

1. Ladders shall be fabricated to support a live load of one hundred (100) lbs. per square foot and a concentrated load of three hundred (300) lbs. per rung; loads not to act simultaneously.

C. Steel Pipe Handrails: Provide Schedule 40 steel pipe of size shown on Drawings. Fittings shall be flush type, malleable of cast iron. Brackets shall be malleable iron, design as selected by the Architect.

1. Construction: Form direction changes in rails using solid bar stock or elbows. Connections shall be shop welded and ground smooth and flush, except where field connections and expansion joints are required. Field connections may be welded, internal sleeve and plug weld, or internal sleeve and set screw.

2. Secure handrails to walls with wall brackets. Provide brackets of malleable iron castings, with not more than three (3) inches clearance from inside face of handrail to wall surface. Neatly drill wall plate portion of the bracket into concrete or masonry to receive bolts for concealed anchorage. For installation at drywall, Drywall trades shall provide plate to receive wall plate portion of bracket and anchor or bolt wall plate through drywall to supporting steel plate. Locate brackets at not more than 5'-0" o.c. unless otherwise shown.

3. Provide wall return fittings of cast iron, flush type, with the same projection as that specified for wall brackets.

4. Longitudinal members shall be parallel with each other and with floor surface or shape of stair to a tolerance of 1/8" in 10'-0" linear feet. Center line of members within each run of railing shall be in the plane.

5. For steel pipe posts where indicated, anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized steel pipe, not less than six (6) inches long and having an inside diameter not less than 1/2" greater than outside diameter of the inserted pipe. Provide steel plate closure secure to bottom of sleeve and of width and length not less than one (1) inch greater than outside diameter of sleeve. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-ferrous grout. Cover anchorage joint with a round steel flange welded to post. Posts shall be set plumb within 1/8" vertical tolerance.

6. Steel pipe handrails shall be capable of resisting a two hundred (200) lb. force applied to rail from any direction and a uniformly distributed load of fifty (50) lbs. per linear foot applied downward or horizontally, loads not to act simultaneously.

D. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

E. Loose Steel Lintels: Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than eight (8) inches bearing at each side of openings, unless otherwise indicated.

1. Loose lintels shall conform to the following Schedule:

Opening Width (Maximum)	WALL THICKNESS		
	4 inches	6 inches	8 inches*
2'-0"	3-1/2" x 3-1/2" x 1/4"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 1/4"
3'-0"	3-1/2" x 3-1/2" x 5/16"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 5/16"
4'-0"	3-1/2" x 3-1/2" x 5/16"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 5/16"
5'-0"	4" x 3-1/2" x 3/8"	6" x 4" x 3/8"	4" x 3-1/2" x 5/16"
6'-0"	5" x 3-1/2" x 3/8"	6" x 4" x 3/8"	5" x 3-1/2" x 5/16"
7'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 1/2"	5" x 3-1/2" x 3/8"
8'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 5/8"	5" x 3-1/2" x 3/8"

* Two angles at all openings in eight (8) inch walls.

2. At columns or vertical surfaces where lintels cannot bear on masonry, provide clip angles sized for structural capacity of lintel.

F. Miscellaneous Light Steel Framing

1. Light steel framing, bracing, supports, framing, clip angles, shelf angles, plates, etc., shall be of such shapes and sizes as indicated on the drawings and details or as required to suit the condition and shall be provided with all necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and all other connecting and adjoining work.

2. All light steel framing steel shall be furnished and erected in accordance with the applicable requirements of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" by the American Institute of Steel Construction and as specified herein.

G. Steel Gratings and Frames: Provide hot dipped galvanized steel gratings with rectangular cross bars welded to bearing bars. Bars to have plain wearing surface.

1. Manufacturer: Provide gratings manufactured by McNichols, IKG, Ohio Gratings, or approved equal.

2. Hinged Section: Provide hinged sections in areaway gratings where required by the drawings. Each hinged section up to 4'-0" wide shall be provided with two (2) five

knuckle, fast pin, regular weight, plain bearing, wrought bronze butt hinges. Each hinged section over 4'-0" wide shall be provided with three (3) butt hinges. Hinged sections shall have provisions for padlocking on the underside.

3. Furnish grating frames, with corners mitered, welded, and ground smooth, and with welded-on straps for secure anchorage into concrete. Frames and anchors to be galvanized.

4. Structural Performance: Provide gratings capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:

   a. Floors: Capable of withstanding a uniform load of 250 lbf/sq. ft. or a concentrated load of 3000 lbf, whichever produces the greater stress.
   b. Walkways and Elevated Platforms Other Than Exits: Capable of withstanding a uniform load of 60 lbf/sq. ft. Limit deflection to L/360 or 1/4", whichever is less.
   c. Walkways and Elevated Platforms Used as Exits: Capable of withstanding a uniform of 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in., whichever produces the greater stress. Limit deflection to L/360 or 1/4", whichever is less.
   d. Sidewalks and Vehicular Driveways: Capable of withstanding a uniform load of 250 lbf/sq. ft. or a concentrated load of 8000 lbf, whichever produces the greater stress.

H. Pit Covers and Frames: Provide minimum 1/2" thick steel checkered plate cover, reinforced as required to limit deflection to 1/360 of span, with two (2) recessed lifting handles capable of supporting five hundred (500) lbs. each. Furnish covers with steel angle frames, with corners mitered, welded, and ground smooth, and with welded-on straps for secure anchorage into concrete. Frames and anchors to be galvanized. Plate covers shall be capable of supporting same loads as adjacent floor surfaces.

I. Structural Steel Door Frames

1. Fabricate steel door frames of structural shapes and bars, fully welded, uniform, square and true. Plug weld built-up members, continuously weld exposed joints; grind exposed welds smooth. Provide 5/8" x 1-1/2" steel bar stops. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than ten (10) inches o.c.

2. Provide necessary reinforcements and drill and tap as required for finish hardware.

3. Provide steel strap anchors for securing door frames into adjoining concrete or masonry, using 1/8" x 2" straps of the length required for a minimum eight (8) inch embedment. Weld anchors to frame jambs no more than twelve (12) inches from both bottom and head of frame and space anchors not more than thirty (30) inches apart.

4. Extend bottom of frames to floor elevation and secure to concrete with steel angle clips welded to frames, anchored with expansion shields and bolts.

J. Cast Thresholds

1. Fabricate of sizes and configurations as shown. Provide cast iron units with integral abrasive finish. Furnish in lengths as required to accurately fit each opening or condition.

   a. Cast units with an integral abrasive grit consisting of aluminum oxide, silicone carbide, or a combination of both.

2. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

    a. Provide two (2) rows of holes for units over five (5) inches wide, with two (2) holes aligned at ends and staggered intermediate holes.

3. Apply black asphaltic coating to concealed bottoms, sides and edges of cast iron units set into concrete.

4. Provide a diamond surface texture.

K. Steel Bollards: Provide six (6) inches O.D. extra strong (Schedule 80) steel pipe, concrete filled, with base of steel plate for mounting to anchor bolts in concrete foundation. Rabbet top of steel pipe and insert 1/4" steel plate cap, flush with top of pipe. Weld top of cap to pipe and grind smooth and flush.

L. Miscellaneous Steel Trim: Provide shapes and sizes for profiles shown. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

M. Corner Guards: Provide steel corner guards where shown. Unless otherwise indicated, use 4" x 4" x 1/4" steel angles to a height of four (4) feet above finished floor with 1-1/4" x 8 1/4" bent steel strap anchors welded to backs of angles at each end and approximately sixteen (16) inches o.c. Set and adjust guards to finish flush with adjacent surfaces.

N. Countertop Supports: Steel framing as indicated or required to support countertops. Conceal framing under countertops and within wall behind countertops. Provide supports to withstand a concentrated load of not less than three hundred (300) lbs. applied at any point with a deflection not to exceed L/240 for the length of the countertop.

O. Trench Drains: Provide Series R-4999 trench frame with Type A grated cover, heavy duty, made of ductile iron as manufactured by Neenah Foundry Co., or approved equal, sizes as shown on drawings. Assembly shall have asphalt coating. Grate shall be bolted in place with stainless steel hex head cap screws.

P. Steel Garage Wall Shelf: Provide 36" wide x 24" deep "Fleximounts" steel garage wall shelf, Model WR26B-E, color Black, or approved equal, in locations indicated on the drawings.

Q. Adjustable roof access prefabricated metal steps/platform: EX-Access Fortess OSHA Stair System, 40-1/2”w x 99”L, Model T9FB2690306.

R. Masonry Support Steel: Provide galvanized steel, relieving angles, plates, accessories, and other steel shapes for masonry support steel; for lintels refer to Para. E. herein.

1. Fabricate masonry support steel to allow final adjustment with the closest tolerances possible. Relieving angles which require cutting to fit masonry flashing shall be straightened without deflections.

2. Coordinate masonry support system with concrete work for locations of wedge inserts.

3. Install to meet requirements of building masonry work, face brick coursing and stone placement. Coordinate final adjustments with masonry work as work progresses.

S. Sleeves in Concrete Walls and Slabs

1. Sleeves through concrete walls shall be of Schedule 40 steel pipe with i.d. two (2) inches larger than o.d. of pipe or conduit (including insulation, if any) to be accommodated. Sleeves shall project one-half (1/2) inch on each side of finished wall. Provide rectangular one-quarter (1/4) inch steel plate collar at center, continuously welded to the perimeter of the sleeve, and six (6) inches wider than the o.d.

2. Slots in slabs shall be 12 gauge steel sheet, galvanized, of dimensions indicated, with strap anchors welded in place not more than twelve (12) inches on centers.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where miscellaneous metal is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 ERECTION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

C. Fitting Connections: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut, or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

E. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

F. Field Touch-Up of Galvanized Surfaces: Touch-up shop applied galvanized coatings damaged during handling and installation. Use galvanizing repair coating specified herein for galvanized surfaces.

END OF SECTION

SECTION 055113 - STEEL PAN STAIRS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the steel pan stairs as indicated on the drawings and specified herein, including, but not limited to, the following:

1. Steel pan stairs, including all clips, hangers, inserts, braces, and other supports.

2. Stainless Steel pipe handrails, guardrails, and intermediate rails for steel stairs, including supports, brackets, and anchors per section 057300.

3. Abrasive nosings.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Miscellaneous Metals - Section 055000.

C. Ornamental metal railings – Section 057300.

D. Installation of inserts in drywall furnished by this Section - Section 092900.

E. Finish painting - Section 099000.

1.4 QUALITY ASSURANCE

A. Qualification of Welders: Use only certified welders and the shielded arc process for all welding performed in connection with the work of this Section. Protect adjacent surfaces when field welding to prevent damage or stain. Welders and welding operators must be qualified by tests as provided by AWS.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with:

1. "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

2. "Code for Welding in Building Construction" of the American Welding Society.

3. "Metal Stairs Manual" of the National Association of Architectural Metal Manufacturers.

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards of these specifications, the provisions of the more stringent shall govern.

D. Field Measurements: If construction process permits, take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress. Allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

E. Tolerances: Allow for construction tolerances as required.

F. Coordination: Coordinate this work with the work of all other trades interfacing with metal pan stairs, such as structural openings, sprinklers and standpipes, and other trades as required.

G. All joint finishes of work of this Section shall be finished to Level 2 as per NOMMA

1.5 DRAWING SUBMISSION

A. General: It is the intent of the Working Drawings to display the layouts and general design parameters upon which the Shop Drawings shall be developed. Detail development and all connections shall be part of Shop Drawing Development.

B. Shop Drawings

1. Before any steel stairs are fabricated, submit shop drawings to the Architect for approval.

2. Show all locations, markings, quantities, materials, sizes and shapes, and indicate all methods of connecting, anchoring, fastening, bracing, for the stair construction, support and attachment to the work of other trades.

C. Engineering Data (calculations)

1. Before any metal pan stairs are fabricated, submit engineering data drawings to the Architect for review. The Contractor is responsible for the structural design and supports for the stair system and must show his proposed system on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of stair members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New York and shall be signed and sealed by this Engineer.

1.6 STAINLESS STEEL SAMPLES SUBMISSION

A. Submit the following listed samples and other samples as may be requested by the Architect, to show the quality standards:

1. Railing bracket.

2. Exposed weld.

3. Exposed bolted connection.

4. Bent pipe railing.

B. Samples shall be submitted cleaned and shop primed and shall represent standards to which all respective materials used in the Project shall meet.

1.7 PERFORMANCE STANDARDS

A. Stairs shall be constructed to conform to the following performance standards, unless greater required by Code:

1. Stairs and platforms shall support a live load of one hundred (100) psf and a concentrated live load of three hundred (300) lbs. and shall have a live load deflection limited to 1/360 of the span. Loads shall not apply simultaneously.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect steel pan stair before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36.

B. Steel Sheets: ASTM A 245, Grade C, minimum ten (10) gauge for platforms, twelve (12) gauge minimum for treads and risers.

C. Steel Pipe: ASTM A 53, Type E., Grade A, and ASTM A 501. Use standard malleable iron fittings for steel pipe.

D. Malleable Iron Castings: ASTM A 47, Grade 35018.

E. Bolts and Nuts: ASTM A 307, Grade A bolts.

F. Machine Screws: ASME B 18.6.3.

G. Expansion Bolts: "Cinch" type, galvanized, of approved manufacture.

H. Threaded End Hanger Rods: Minimum 3/4" diameter, ASTM A 36.

I. Shop Paint: Shop prime all stairs and railings using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

J. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.

K. Concrete Fill and Reinforcing Materials

1. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi.

2. Nonslip-Aggregate Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

3. Welded Wire Fabric: ASTM A 185, 6 by 6 inches – W1.4 by W1.4, unless otherwise indicated.

L. Railings: See Section 057300.

M. Abrasive Nosings: Extruded-aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions. Provide units manufactured by Amstep Products, or approved equal.

1. Provide solid-abrasive-type units without ribs. At exit stairs, provide in contrasting color per NYS IBC 7.2.2.5.5.1 Exit Stair Treads. Comply with photoluminscent requirements.

2. Nosings: Square-back units, 3 inches wide, without lip for concrete, with lip for steel pan.

2.2 FABRICATION

A. General

1. Steel pan stair work shall be fabricated by an experienced manufacturer in accordance with approved shop drawings and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand strains and stresses to which material will be subjected.

2. Fabricate shop assemblies in largest practical sizes to minimize field work. All exposed surfaces shall be clean and free from all dirt, stains, grease marks, scratches, waves, dents, buckles, tool marks, rattles, and other objectionable defects which mar appearance or use of finished work.

3. Cutting: Cut materials by sawing, shearing, or blanking. Flame cutting will be permitted when ground back to clean edges. Cuts shall be made accurately, clean, sharp and free of burrs, without deforming adjacent metals.

4. Connections: Make connections with tight joints, capable of developing full strength of the members, flush. Locate joints where least conspicuous. Use concealed fasteners where possible. Weld or rivet shop connections; bolt, screw or weld field connections.

a. Welding: Welds shall be continuous, except where spot welding is specifically permitted. Welding shall conform to the Standard Code of the American Welding Society. Exposed welds are required to be ground flush.
b. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts, or upset thread ends. Exposed bolts and screw head shall be flat and countersunk, unless otherwise indicated on drawings. Remove projecting ends of bolts and screws. Punch or drill holes; do not burn.

B. Stairs and Platforms

1. Provide stringers, risers, tread, tread support and platforms matching profiles as shown. Form tread pan and riser in a continuous piece to receive the finished tread; tread shall be

a minimum of twelve (12) gauge. Weld risers and treads to tread support which shall be welded to the structural steel stringers. Fasten countersunk bolts or stud welded clips through mesh for cement fill. Provide welded-on clips for the support of gypsum drywall soffits.

2. Properly fit and securely fasten together all parts making exposed joints close fitting. Cut, drill, punch and tap as required for installation.

3. Make joints as strong and rigid as adjoining sections. Weld continuously along entire line of contact except where spot welding is indicated.

4. Closure and Filler Plates: Where indicated on drawings or as required, at least twelve (12) gauge sheet steel, securely fastened to top and bottom of stringer and adjacent wall, by welding or screws.

5. Struts, Platform Headers and Subframing

   a. Provide supports as detailed and required, including all struts, clip angles, angles which are required and necessary for support of stair construction.
   b. Supports shall be of size suitable for the support load, as required. Struts, angles shall be supported by and directly connected to the structural, load bearing CMU wall. Struts with their connections, shall be concealed.
   c. Provide other inserts, anchors and/or other subframing as may be required to complete the stair construction and properly support it on the CMU Wall.

2.3 SHOP PAINTING

A. Scope: All ferrous metal shall be cleaned and shop painted with one coat of specified ferrous metal primer.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel pan stairs are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Work in the field shall comply with the same requirements as specified for shop work above.

B. Except where otherwise shown or specified for a particular item of work or for built-in work, fasten metal work to solid masonry with expansion bolts. Fastenings to wood plugs in masonry will not be accepted. Drill holes to the exact diameter of the bolts using a rotary drill for concrete and a percussion drill for other masonry. Thread screws full length to the head of the screw.

C. Provide connecting members needed for properly securing the work to masonry, drywall and structural framing, including bolts, machine screws, rods, hangers, inserts, sleeves, plates, anchors, expansion bolts, washers and other items as required. Furnish built-in items to drywall trades as required for proper anchorage.

D. Leave work exposed to view, including stair soffits, clean, smooth and neatly finished. All exposed welds shall be dressed smooth. Comply with Level 2 per NOMMMA.

E. Include supplementary parts necessary to complete each item even though such work is not definitively shown or specified.

F. Coordinate and schedule the work of this Section with the work of other trades. Furnish anchors, sockets, fastenings and other miscellaneous items to be embedded in concrete or masonry, or required for securing metal work to other construction so as not to delay job progress.

G. Attach wall railings to the wall construction, using appropriate bolts and anchors to meet performance standards.

H. Install work plumb and true to the exact lines and levels, in the correct location and in proper relation to adjoining work.

I. Touch up marred and abraded shop paint of exposed surfaces after erection in the field.

J. Posts shall be set plumb within 1/8" vertical tolerance. Longitudinal members shall be parallel with each other and with floor surface or slope of stair to a tolerance of 1/8" in ten (10) linear feet. Center lines of members within each run of railing shall lie in the same vertical plane. Field joints of connecting sections shall be hairline.

3.3 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop coat, and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION

SECTION 057300 - ORNAMENTAL METAL RAILINGS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the ornamental metal railings as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Stainless steel handrails and guardrails at stairs.

1.3 RELATED SECTIONS

A. Steel pan stairs – Section 055113.

1.4 QUALITY ASSURANCE

A. General: Work of this section shall be fabricated and installed by an experienced fabricator or manufacturer who has been engaged in work of equivalent scope and fabrication standards for at least five (5) years. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings, specifications, and approved shop drawings, and be of highest quality practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. All work shall be accurately and neatly fabricated, assembled, and erected.

B. Single-Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

C. Engineer Qualifications: Professional engineer legally authorized to practice in the State of New York and experienced in providing engineering services of the kind indicated for handrails and railing systems similar to this Project in material, design, and extent, and that have a record of successful in-service performance.

D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work. However, do not delay job progress; allow for adjustments and fitting where taking of field measurements before fabrication might delay the work.

E. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Work that cannot be permanently shop assembled, shall be completely assembled, marked, and disassembled in shop before shipment to insure proper assembly in field. Shop assemble work in largest practical sizes to minimize field work. It is the responsibility of the Contractor for this work to assure himself that the shop fabricated items will properly fit the field condition. In the event that shop fabricated items do not fit the field condition, the item shall be returned to the shop for correction.

1.5 SUBMITTALS

A. Shop Drawings: Submit for all items of work of this Section, as enumerated under paragraph 1.2, showing locations, layouts, materials, thicknesses, finishes, dimensions, construction, relation to adjoining construction, erection details, profiles, jointing and all other details to fully illustrate the work of this Section.

B. Samples: Submit fabricated samples (of sufficient size to fully show construction, materials, and finishes) of all items of work as enumerated under paragraph 1.2 herein.

C. Product Data: Submit manufacturer's, fabricator's and finisher's specifications and installation instructions for products used in ornamental metal work, including finishing materials and methods.

D. Samples for Verification: For each type of exposed finish required, prepared on 12" x 12" samples of metal of same thickness and material indicated for the Work.

E. Contractor Licensed Engineer Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments and necessary clearances.

1.6 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. 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 to masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

1.8 PERFORMANCE STANDARDS FOR RAILINGS (UNLESS GREATER REQUIRED BY CODE)

A. Railing assemblies shall be designed and installed to resist the simultaneous application of a lateral force of 50 PLF and a vertical load of 100 PLF, both applied to the top of the railing. Railings shall resist a total lateral force and total vertical load of at least 200 lbs. each.

B. Submit calculations and drawings signed and sealed by a Professional Engineer licensed in the State of New York indicating that railing system can meet these performance criteria.

PART 2 PRODUCTS

2.1 MATERIALS

A. All work of this section shall be finished to Level 2 as per NOMMA.

B. Provide materials that have been selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in the finished unit. Surfaces exposed to view that exhibit pitting, seam marks, roller marks, oil-canning, stains, discolorations, or other imperfections on the finished units will not be acceptable.

C. Stainless Steel: Comply with the following standards for the forms and types of stainless steel for the required items of work.

1. Tubing: ASTM A 554, Grade MT 316.

2. Pipe: ASTM A 312, Grade TP 316.

3. Castings: ASTM A 743, Grade CF 8M or CF 3M.

4. Sheet, Strip, Flat Bar and Plate: ASTM A 666, Type 316.

5. Bars and Shapes: ASTM A 276, Type 316.

D. Exposed Steel (cold rolled)

1. Structural Shapes and Sheets: ASTM A 1008.

2. Strip: ASTM A 109.

E. Steel (Carbon) for Concealed Supports Only

1. Structural Shapes: ASTM A 36.

2. Plates (for forming or bending cold): ASTM A 283, Grade C.

3. Steel Sheets: ASTM A 366, Grade 1.

4. Shop prime with rust inhibitive primer equal to Series 88 Azeron made by Tnemec, or approved equal made by Benjamin Moore or Sherwin Williams.

F. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of the metal to be welded, and as required for color match, strength and compatibility in the fabricated items.

G. Fasteners: Furnish basic metal and alloy, matching finished color and texture as the metal being fastened, unless otherwise indicated. Provide Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

H. Anchors and Inserts: Either furnish inserts to be set in concrete or masonry work, or provide other anchoring devices as required for the installation of ornamental metal items. Provide toothed steel or lead shield expansion bolt devices for drilled-in-place anchors. Provide galvanized or cadmium-coated anchors and inserts for exterior installations.

1. Provide units with exposed surfaces matching the texture and finish of the metal item anchored.

I. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

J. Cast-in-Place and Preinstalled Anchors: Anchors fabricated from corrosion-resistant materials 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.

K. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.

1. Sealants shall have a VOC content of not more than 250 g/l when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

L. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by produced of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

2.2 FABRICATION

A. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp, square, and free of burrs, without deforming adjacent surfaces or metals.

B. Holes: Drill or cleanly punch holes (do not burn), so that holes will be accurate, clean, neat and sharp without deforming adjacent surfaces or metals.

C. Connections

1. Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to water. Locate joints where indicated on drawings. Provide connections to allow for thermal movement of metal at locations and by methods approved by Architect. For work exposed to view, use concealed fasteners (unless welded or other connections indicated) with joints accurately fitted, flush and rigidly secured with hairline contacts. All edges within public reach shall be eased.

2. Welding: Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces so that joint will not be visible; undercut metal edges where welds are required to be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. Remove weld splatter and welding oxides from all welded surfaces.

3. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads, where shown to be exposed to view, shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts of adjacent metal.

D. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items for architectural metal work to be built into concrete, masonry, or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

E. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

F. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

G. Exposed Work: In addition to requirements specified herein or shown on drawings, all surfaces exposed to view shall be clean, and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs and other defects which mar appearance of finished work. Ornamental metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design. Exposed fastenings, where permitted, shall be of the same material, color, and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

H. Materials used shall be of such strength, thickness, and alloy that they are capable of meeting all standards and descriptions specified herein and as detailed on drawings.

I. Bending: Bend sheet metal to the required shape. Bent items shall be free of grain separation, oil canning or other distortion.

1. Square Bends: Back-cut sheets to attach maximum square bend possible, with maximum radius of 1/16 in.

2. Knife Edge Bends: Back-cut and back bevel sheets to attain sharpest bend possible, with maximum radius of 1/32 in.

2.3 SHOP FINISHING

A. General

1. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated.

2. Provide colors or color matches as indicated on selected samples.

3. Protect mechanical finishes on exposed surfaces from damage by application of strippable temporary protective covering prior to shipment.

4. Corrosion Protection: Coat concealed surfaces which will be in contact with concrete, masonry, wood or dissimilar metals, in exterior work and work to be built into exterior and below grade walls and decks, with a heavy coat of bituminous paint. Do not extend coating onto exposed surfaces.

B. Stainless Steel

1. Remove or blend tool and die marks and stretch lines into finish.

2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

3. Finish: Brushed finish.

4. When polishing is complete, passivate and rinse surfaces. Remove foreign matter and leave surface chemically dry.

2.4 PROTECTION

A. Provide necessary protection to all exposed surfaces of architectural metal work, so as to prevent damage, staining, discoloration, abrasion, etc., to these surfaces from time of shipment from factory to acceptance of work of this project. Protection shall be provided by wrappings, strippable coatings, or other means. After installation, remove protective paper or strippable coating and clean exposed surfaces, and then provide additional temporary protection to protect architectural metal work from damage during subsequent construction activities. Surfaces which are damaged, stained, discolored, abraded etc., shall be rejected and replaced with new materials, at no cost to the Owner.

2.5 STEEL FRAMING, BRACING, SUPPORTS AND REINFORCEMENTS

A. Steel framing, plate reinforcing, supplementary steel framing or reinforcing, bracket assemblies, and the like required for the support, framing, reinforcing, bracing, etc., of work of this Section shall be of such sizes and shapes as indicated on the drawings, or as required to suit the conditions, and shall be provided with all necessary supports and accessory items such as inserts, hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly and rigidly fasten, anchor or attach work of this Section in place and to the concrete, masonry and other connecting and adjoining work.

2.6 ORNAMENTAL METAL HANDRAILS AND RAILINGS

A. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

5. Form changes in direction of railing members by radius bends.

6. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member

throughout entire bend without buckling, twisting, or otherwise deforming exposed surfaces of handrail and railing components.

7. Provide wall returns at ends of wall-mounted handrails, close ends of returns.

8. Close exposed ends of handrail and railing members with prefabricated end fittings.

9. Brackets, Flanges, Fittings, and Anchors: Provide brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

   a. Furnish inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
   b. For railing posts set in concrete, provide preset sleeves of steel, not less than 6 inches long and inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where ornamental metal work is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Install work of this Section square, plumb, straight, true to line or radius, accurately fitted and located, with flush, tight hairline joints (except as otherwise indicated or to allow for thermal movement), with provisions for other trades, with provisions to allow for thermal movement, with provisions to exclude water where exposed to weather, and with attachment devices as required for secure and rigid installation. It is the responsibility of the Contractor to assure himself that shop fabricated architectural metal items will properly fit the field condition. In cases where the shop fabricated architectural metal items do not fit the field condition, the item shall be returned to the shop for correction.

B. Attachments

1. Unless otherwise indicated, work to be built into concrete or masonry shall be anchored with shop welded on galvanized steel strap anchors; work to be attached to concrete or masonry shall be anchored by bolts into embedded inserts or expansion shields; work attached to structural steel shall be anchored by welds or bolts; work attached to metals other than structural steel shall be anchored by bolts or screws. Power actuated fasteners not permitted unless approved by Architect. Provide all supplementary parts necessary to complete each item of work of this Section.

2. All attachment devices shall be of type, size and spacing to suit condition and as approved by Architect. Provide shims, slotted holes, or other means necessary for leveling, plumbing and other required adjustments. Attachment devices for work exposed to view

shall be concealed, unless indicated otherwise. Where bolts or screws are permitted in work exposed to view, they shall be oval head and counter sunk, unless otherwise noted, with projecting end cut off flush with nuts or adjacent material and shall match adjacent surfaces.

3. Do all necessary drilling, tapping, cutting or other preparations of surrounding construction in the field accurately, neatly, and as necessary for the attachment and support of work of this Section, but obtain Architect's approval prior to such preparation to work of others.

C. Tolerances: All work of this Section shall be plumb, square, level, true to radius and correctly aligned within the following limitations:

1. Offset from true horizontal, vertical and design location shall not exceed 1/16" per ten (10) feet of length for any component, not cumulative.

2. Maximum offset from true alignment between abutting components shall not exceed 1/32".

D. Do not cut or abrade finishes which cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units at Contractor's option.

E. Restore protective coverings which have been damaged during shipment or installation of the work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.

F. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.

G. Field Welding: Comply with AWS Code for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

3.3 CLEANING AND PROTECTION

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Protect finishes of ornamental metal from damage during construction period with temporary protective coverings approved by ornamental metal fabricator. Remove protective covering at the time of Substantial Completion.

C. Restore finishes damaged during construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

SECTION 061643 - GYPSUM SHEATHING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the gypsum sheathing as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Glass-reinforced gypsum sheathing board.

2. Sheathing joint-and-penetration treatment.

1.3 RELATED SECTIONS

A. Air Barrier - Division 7.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 (UL 263, CAN/ULC-S101) by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from ULI and ULC "Fire Resistance Directory."

B. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.

2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.

6. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

7. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

C. Single Source Responsibility: Except where specified otherwise, obtain gypsum board products, joint treatment, and accessories from single manufacturer or from manufacturer's recommended by prime manufacturer of gypsum board products.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Informational Submittals: Submit manufacturer's instructions, special procedures, and perimeter conditions requiring special attention.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials protected against damage from weather, direct sunlight, surface contamination, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1. Store and support sheathing board in flat stacks to prevent sagging.

2. Protect materials to keep them dry.

3. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.

1.7 WARRANTY

A. Manufacturer's standard warranty for product exposed to weather without failure, when installed in accordance with manufacturer's requirements, for period of not less than 12 months.

B. Five years against manufacturing defects.

PART 2 PRODUCTS

2.1 GYPSUM SHEATHING

A. "Dens-Glass Fireguard," Type X, made by Georgia Pacific, "Securock Glass-Mat Sheathing" made by U.S. Gypsum Co., "GlasRoc Brand Sheathing" by CertainTeed Gypsum, Inc., or approved equal, meeting ASTM C 1177.

1. Type and Thickness: Type X, 5/8" thick where indicated and as otherwise required to meet fire rating for specific element.

a. Flame Spread: ASTM E 84: 0 maximum.
b. Smoke Developed: ASTM E 84: 0 maximum.

2. Size: 48" by not less than 96"; longer lengths as available to reduce number of joints.

2.2 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

A. Silicone Sealant: Meeting ASTM C 920, Type S, Grade NS, compatible with glass fiber mesh sheathing tape and for covering exposed fasteners.

B. Glass-Fiber Mesh Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for

use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.3 ACCESSORY MATERIALS

A. Fasteners: Steel drill screws or nails, in lengths recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating. For ceiling/soffit applications with Direct-Applied Exterior Finish Systems (DEFS) and painted ceilings/soffits, fasteners having a salt spray resistance of more than 800 hours according to ASTM B 117 are recommended.

1. For steel framing less than 0.0329" thick, attach sheathing with steel drill screws complying with ASTM C 1002.

2. For steel framing from 0.033" to 0.112" thick, attach sheathing with drill screws complying with ASTM C 954.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where gypsum sheathing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Coordinate wall sheathing installation with flashing and joint-sealant installation so that these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253, ASTM C 1280 and manufacturer’s written instructions.

B. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

1. Install boards with a 3/8-inch setback where non-load-bearing construction abuts structural elements.

2. Install boards with a 1/4-inch setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.

3. Allow no joints greater than 1/8 inch.

C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevents exterior moisture from passing through completed exterior wall assembly.

D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. Fasten sheathing to exterior of each stud with specified fasteners spaced 3/8" from ends and edges and approx. 8" o.c. at each stud. Install fasteners in accordance with manufacturer's recommendations using 2500-RPM maximum screw gun. Sheathing board shall be installed horizontally. Apply sealant between joints and trowel flush; and apply sealant around sheathing perimeter and at interface with other materials. Cover fastener heads with sealant and trowel flush.

G. Refer to Section 072700 for air barrier description.

3.4 SHEATHING JOINT AND PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written recommendations.

1. Short Term: Apply elastomeric sealant on joints and trowel flat. Apply sufficient quantity of sealant to completely cover joints after troweling. Seal other penetrations and openings.

2. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION

SECTION 062000 - CARPENTRY

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the carpentry work as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Blocking and miscellaneous wood.
2. Plywood backing panels for telephone and electrical closets.
3. Raised floor perforated fascia at Ground Floor Front Desk.
4. Rough hardware.
5. Installation only of finish hardware.
6. Installation only of doors and hollow metal frames.

1.3 RELATED SECTIONS

A. Architectural Woodwork - Section 064023.

B. Roofing - Division 7.

C. Steel Doors and Frames - Section 081113.

D. Finish Hardware - Section 087100.

1.4 QUALITY ASSURANCE

A. Lumber Standard: Comply with PS 20.

B. Plywood Standard: Comply with PS 1 and American Plywood Assoc. (APA).

C. Shop fabricate carpentry work to the extent feasible and where shop fabrication will result in better workmanship than feasible for on-site fabrication.

D. Grade Marks: Identify lumber and plywood by official grade mark.

1. Lumber: Grade stamp to contain symbol of grading agency certified by Board of Review, American Lumber Standards Committee, mill number or name, grade of lumber, species grouping or combination designation, rules under which graded where applicable, and condition of seasoning at time of manufacture.

a. S-Dry: Maximum nineteen (19) percent moisture content as per ASTM D 2016.

E. Installation of doors, frames and hardware shall conform to the minimum standards of "Installation Guides for Doors and Hardware" of the Door and Hardware Institute.

1.5 SUBMITTALS

A. Pressure Treatment: Include certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

B. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

1.6 PRODUCT HANDLING

A. Deliver carpentry materials to the site ready to use with each piece of lumber clearly marked as to grade, type and mill, and place in an area protected from the elements.

B. Deliver rough hardware in sealed kegs and/or other containers which shall bear labels as to type and kind.

C. Pile lumber for rough usage, when delivered to the site in stacks to insure drainage and with a minimum clearance of six (6) inches above grade. Cover stacks with tarpaulins or other watertight coverings. Store grounds and similar small sized lumber inside the building as soon as possible after delivery.

D. Do not store seasoned lumber in wet or damp portions of the building.

E. Protect fire retardant treated materials against high humidity and moisture during storage and erection.

F. Remove delivered materials which do not conform to specified grading rules or are otherwise not suitable for installation from the job site and replace with acceptable materials.

G. All items specified in Section 087100 of this specification entitled "Finish Hardware" shall be received, accounted for, stored and applied under this Section.

H. Hardware shall be sorted and stored in space assigned by Contractor and shall be kept at all times under lock and key. The safety and preservation of all items delivered will be the responsibility of the Contractor.

1.7 JOB CONDITIONS

A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer and the Architect.

B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other work.

PART 2 PRODUCTS

2.1 WOOD MATERIAL

A. General

1. All wood shall be sound, flat, straight, well-seasoned, thoroughly dry and free from all defects. Warped or twisted wood shall not be used.

2. For miscellaneous wood blocking, grounds, furring as required, use Utility Grade Coastal Douglas Fir or Southern Pine, free from knots, shakes, rot or other defects, straight, square edges and straight grain, air seasoned with maximum moisture content of nineteen (19) percent. Wood shall be S4S, S-Dry, complying with PS-20.

3. Plywood and rough carpentry for telephone and electrical closets, provide 3/4" thick C-D EXT-APA plywood, fire retardant treated as specified herein.

4. Raised Floor Perforated Fascia at Ground Floor Front Desk: Paint yellow; provide sign reading "Watch Step," located as indicated. Refer to door schedule.

B. Wood Treatment

1. All interior wood material specified herein shall be fire retardant treated to comply with the AWPA standard U1 to achieve a flame spread rating of not more than 25 (UL Class "FR-S") when tested in accordance with UL Test 723 or ASTM E 84. The fire-retardant chemicals used to treat the lumber must comply with FR-1 of AWPA Standard P49 and be free of halogens, sulfates and ammonium phosphate.

   a. After treatment, kiln dry to a moisture content of fifteen (15) percent; if wood is to be painted or finished, kiln dry to a moisture content of twelve (12) percent. Treatment shall be equal to "Dricon" made by Arch Wood Protection Inc. or approved equal. Provide UL approved identification on treated materials.

2. For exterior blocking, roofing and sheet metal, pressure treat wood with copper azole, Type B (CA-B); ammoniacal copper quat (ACQ) or similar preservative product that contains no arsenic or chromium. Preservative shall comply with AWPA Standard U1, (.25 lbs./cubic foot of chemical in wood).

   a. After treatment, kiln dry to a maximum moisture content of fifteen (15) percent. Treatment shall be equal to "Wolmanized Natural Select" made by Arch Wood Protection Inc. or approved equal.

3. Treated wood which is cut or otherwise damaged shall be further treated in accordance with the AWPA Standard M-4.

2.2 HARDWARE

A. Rough Hardware for Treated Woods and Exterior Use: Hot-dipped galvanized or Type 304 stainless steel.

B. Nails: Common steel wire, untreated for interior work as per ASTM F 1667.

C. Bolts: Standard mild steel, square head machine bolts with square nuts and malleable iron or steel plate washers or carriage bolts with square nuts and cut washers conforming to the following:

1. Bolts: ASTM A 307, Grade A.

2. Nuts: ASTM A 563.

3. Lag Screws and Bolts: ASME B 18.2.1.

D. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material for Treated Woods and Exterior Use: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

E. Wood Screws: ASME B 18.6.1.

F. Concrete and Masonry Anchors: Standard expansion-shield self-drilling type concrete anchors where so shown or noted on the drawings, or where approved by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpentry is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION OF FINISH HARDWARE

A. Hardware shall be carefully fitted and securely attached, in accordance with these specifications and the instructions of the various manufacturers.

B. Unless otherwise noted, mount hardware units at heights established in Section 081113.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

G. All keys used shall be construction keys which are to be tagged with fiber discs as approved, clearly labeled with identifying inscriptions and then neatly arranged in a temporary cabinet. All construction keys shall be returned to the Owner.

H. Adjusting and Cleaning

1. Adjust and check each operating item of hardware and each door, to ensure proper operation and function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

2. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.3 INSTALLATION OF DOORS AND FRAMES

A. Preparation

1. Remove welded-in shipping spreaders installed at factory.

2. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

B. Installation

1. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

2. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Install frames in accordance with ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames, unless more stringent requirements are specified herein.
    b. At fire-protection-rated openings, install frames according to NFPA 80.
    c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    d. Install frames with removable glazing stops located on secure side of opening.
    e. Frames set in masonry walls shall have door silencers installed in frames before grouting.
    f. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    g. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames conforming to the requirements of Section 072100 "Thermal Insulation."

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar; refer to Section 042000 "Unit Masonry" for installation of frames in masonry walls.

6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

7. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the tolerance given in HMMA 841 of ANSI/NAAMM, current edition.

8. Steel Doors: Fit hollow metal doors accurately in frames to the tolerances given in HMMA 841 of ANSI/NAAMM, current edition.

    a. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

9. Glazing: Comply with installation requirements in Section 088000 "Glass and Glazing" and with standard steel door and frame manufacturer's written instructions.

    a. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

C. Adjustments: Check and readjust operating finish hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

3.4 BLOCKING AND MISCELLANEOUS WOOD

A. General

1. Erect rough carpentry true to line, levels and dimensions required; squared, aligned, plumbed, and securely fastened in place.

2. Shim where required to true up furring, blocking and the like. Use wood or metal shims only.

3. Do all cutting, fitting, drilling and tapping of other work as required to secure work in place and to perform the work included herein. Do all the cutting and fitting of carpentry work, for the work of other trades as required.

B. Blocking and Miscellaneous Wood

1. Furnish and install all wood grounds, furring, blocking, curbs, bucks, nailers, etc., that may be necessary and required in connection with the carpentry and with the work described for any other trades and including required carpentry for electrical fixtures. All blocking and nailers shall be continuous wherever required, whether or not so indicated.

2. Blocking shall be as required for the proper installation of the finished work and for items in mechanical sections as required. Blocking, edgings, stops, nailing strips, etc., shall be continuous, unless distinctly noted otherwise. Provide blocking as required to install all equipment. Provide blocking and nailers where shown or required to fasten interior sheet metal work.

3. Fastening for wood grounds, furring and blocking shall be of metal and of type and spacing as best suited to conditions. Hardened steel nails, expansion screws, toggle bolts, self-clinching nails, metal plugs, inserts or similar fastenings shall be used, of suitable type and size to draw the members into place and securely hold same.

C. Rough Lumber for Roofing and Sheet Metal

1. Furnish and install all wood nailing strips and wood blocking required in connection with respective types of roofing, fans, flashings, and sheet metal work, using preservative treated wood as herein before specified.

2. Wood blocking shall be of sizes and shapes as indicated on the drawings and/or designed for the reception of curb flashings for roof ventilators and similar items.

3. All nailing strips and blocking shall be carried out in accordance with the printed installation instructions, and/or recommendations of the accepted manufacturer of the roofing materials, and in coordination and cooperation with the sheet metal work trades.

4. All blocking and nailing strips shall be firmly secured in place using counter bored bolt and nut fastenings, or secured by any other proposed flush surfaced fastenings.

5. Wood nailing strips or blocking required to be embedded in concrete work shall be furnished in time due for placing, prior to start of concrete operations. Locations and

spacings of nailing strips or blocking shall be performed in coordination with the concrete trades, as required for respective installations.

3.5 TELEPHONE AND ELECTRICAL EQUIPMENT MOUNTING BOARDS

A. Furnish and install 3/4" thick plywood panels to the walls of the telephone and electrical equipment rooms in accordance with the requirements of the local utility company.

B. Secure to wall using proper devices for substrates encountered, spaced twelve (12) inches o.c., maximum around the edges, 1-1/2" from corners, and in three (3) rows of three (3) each in the field. Recess fastening devices flush with the plywood surface. Adjacent panels shall be butted with 1/16" space between without lapping.

3.6 ROUGH HARDWARE

A. Securely fasten rough carpentry together. Nail, spike, lag screw or bolt as required by conditions encountered in the field and the Contract Documents.

B. Provide rough or framing hardware, such as nails, screws, bolts, anchors, hangers, clips, inserts, miscellaneous fastenings, and similar items of the best quality and of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner.

C. Secure rough carpentry to masonry with countersunk bolts in expansion sleeves or other acceptable manner, with fastenings not more than sixteen (16) inches apart. Secure woodwork to hollow masonry with toggle bolts spaced not more than sixteen (16) inches apart.

D. Countersink bolts in nailers and other rough woodwork and include washers and nuts. Cut bolts off flush with surfaces and peen as may be required to receive finished work.

E. Inserts to secure wood nailers to concrete shall be malleable iron threaded inserts with 3/8" diameter bolts of length to allow for countersinking. Locate at end of each nailer and at intervals not exceeding thirty (30) inches o.c.

F. Furnish to the mason for building into the work, or attaching the work which is to be built in, anchors, bolts, wall plates bolted to masonry, corrugated wall plugs, nailing blocks, etc., which are required for the proper fastening and installation for the work or other items as called for in this Section.

G. Detailed instructions with sketches of necessary requirements, shall be given to the masonry trade showing the location and other details of such nailing devices.

3.7 CLEANING UP

A. General: Keep the premises in a neat, safe and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends and debris.

B. Sweeping

1. At the end of each working day, or more often if necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled.

2. Remove the refuse to the area of the job site set aside for its storage.

3. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

END OF SECTION

SECTION 064023 - ARCHITECTURAL WOODWORK

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the architectural woodwork as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Wood millwork and counters with wood veneers.
2. Wood millwork and counters with colored through plastic laminate finish.
3. Hardware for architectural woodwork.
4. Wood shelving.
5. Solid surfacing material countertops.
6. Linoleum surfacing.
7. Wood framing and rough lumber as required for work of this Section.
8. Wood grounds, blocking, nailers, furring as required for work of this Section.
9. All rough hardware and fastenings for work of this Section.
10. Drilling concrete and masonry, drilling and/or tapping metal work, as required, for the installation of work of this Section.
11. Back painting as specified herein.
12. Shop finish of work of this Section, except items indicated herein to be shop primed only.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Caulking between architectural woodwork and any wall, floor, or ceiling joints - Section 079200.

C. Field finishing of architectural woodwork - Section 099000.

1.4 QUALITY STANDARDS

A. The quality standards of the Architectural Woodwork Institute, "Architectural Woodwork Standards" (AWS), 2nd Edition, dated July 1, 2016, shall apply to all workmanship, including materials and installation, for architectural woodwork, and by reference are made a part of this

specification. All work shall conform to "Premium" grade requirements of the AWS unless otherwise modified herein.

B. In the event of a dispute as to the quality grade (or grades), the Contractor shall call upon the Architectural Woodwork Institute for an inspection under AWI's Quality Certification Program which shall include a QCP Inspection and Report. The Contractor agrees to abide by the decision of this Report. The cost of said inspection and report shall be borne by the Contractor.

C. Employ only tradesmen experienced in the fabrication and installation of architectural woodwork.

D. Woodworking firm must be accredited by the AWI Quality Certification Program (QCP).

E. Provide fire test reports by an accredited testing laboratory of all woodwork demonstrating compliance with fire rating classification as required by Code.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings of all woodwork specified and indicated on the drawings. Shop drawings shall indicate room plans and elevations at 3/4" equals 1'-0" scale and typical construction details at 3" equals 1'-0" scale. Shop drawings shall indicate all materials, thicknesses and finishes.

2. Shop drawings shall show all finish hardware, anchors, fastenings and accessories.

3. Shop drawings shall show all jointing, joint treatment and butt jointing in veneers and plastic laminate.

4. Shop drawings for cabinet work must show centerline height and horizontal location of all required internal wall blocking.

5. Where architectural woodwork deviates from AWI standards noted herein, shop drawings must identify these deviations.

B. Samples: Submit samples of each of the following items:

1. Plastic laminate, twelve (12) inches square, including a section of outside corner.

2. Transparent finish for each species of wood veneer laminated to particleboard, twelve (12) inches square, for each finish specified or shown.

3. Opaque finish wood veneer laminated to particleboard, twelve (12) inches square for each color, gloss and finish specified or shown.

4. Cabinet hardware.

1.6 QUALIFICATIONS

A. The work of this Section shall be provided by a firm having a minimum of five (5) years' experience on projects of similar size and quality to that specified and shown.

1.7 COORDINATION

A. Coordinate the work of this Section with other appropriate Sections of the specifications to insure proper scheduling for fabrication and installation of the work specified herein.

B. Coordinate with partition and finish trades to insure that proper provisions are made for the installation of the work specified herein.

C. Verify all dimensions in the field prior to fabrication of all Architectural Woodwork to assure proper fit.

1.8 PRODUCT HANDLING

A. All materials and work of this Section shall be protected from damage from time of shipment from shop to final acceptance of work. Cover, ventilate, and protect work of this Section from damage caused by weather, moisture, heat, staining, dirt, abrasions, any other causes which may adversely affect appearance or use, or which may cause deterioration of finish, warping, distortion, twisting, opening of joints and seams, delamination, loosening, etc., of work of this Section.

B. Keep all finish carpentry, millwork, and cabinet work under cover both in transit and at the premises. Do not deliver any finish carpentry, millwork or cabinet work before it is required for installation. Protect such work to avoid damage in transit, during erection and after erection until acceptance of the building; use all such methods to provide the proper protection. Remove such protection when directed by the Architect.

C. Deliver finish carpentry, millwork, and cabinet work in a dry stable condition; protect same against injury and dampness. Do not store or install finish carpentry, millwork or cabinet work until after the concrete, masonry and plaster work are thoroughly dry.

D. Damaged or defective items of work of this Section are subject to rejection and replacement with new by Contractor, at no cost to Owner.

1.9 JOB CONDITIONS

A. Humidity Controls: The ambient relative humidity at the site, including both the storage and the installation areas, shall be maintained between 25% and 55% prior to delivery and through the life of the installation.

B. Determine equilibrium moisture content and maintain required temperature and relative humidity as required for a tolerance of plus or minus one (1) percent of the specified optimum moisture content until woodwork receives specified finishes. Refer to "Guide to Wood Species Selection," AWI, for method of determining equilibrium moisture content values.

C. Examination of Substrate and Conditions: The installer must examine the substrate and the conditions under which the work of this Section is to be performed, and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with work under this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

D. Areas to receive architectural woodwork must be fully enclosed with windows and/or curtain wall installed and glazed, exterior doors in place, HVAC systems operational, and temporary openings closed. Any plaster, wet grinding and concrete work shall be fully dry.

E. Architectural woodwork shall be allowed to come to equilibrium on site for 7 days prior to installation.

PART 2 PRODUCTS

2.1 BASIC REQUIREMENTS

A. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average moisture content range of nine (9) to twelve (12) percent for exterior work and six (6) to eleven (11) percent for interior work.

B. Measurements: Before proceeding with woodwork required to be fitted to other construction, obtain field measurements and verify all dimensions of shop drawing details as required for accurate fit.

C. Compatibility of Grain and Color: Architect reserves the right to select materials for best compatibility between visually related members and veneers.

D. Machine and sand woodwork to comply with requirements of Standards for specified grade.

E. Fabricate woodwork to dimensions, profiles and details shown. Rout or groove back of flat trim members, kerf backs of other wide flat members except plywood or veneered members.

F. Miter joints by joining, splining and gluing to comply with requirements for the specified grade.

G. Inspect each piece of lumber and plywood or each unit of woodwork after drying; do not use twisted, warped, bowed or otherwise damaged or defective wood.

2.2 GENERAL - MATERIALS

A. Softwood lumber shall conform to the requirements of the latest edition of American Lumber Standards Simplified Practice Recommendation R-16. Grades shall conform to the grading rules of the Association having jurisdiction, and shall bear the official grade and trademark of the Inspection Bureau of the Association and a mark of mill identification.

B. Framing and Rough Lumber: No. 1 KD grade Southern Pine or Dense Construction grade Douglas Fir, having extreme fiber in bending stress of at least 1700 psi, surfaced four sides (S4S). Provide fire retardant treatment meeting requirements of Section 062000.

C. Grounds, Blocking, Nailers, Furring: Southern Pine, Douglas Fir or Sitka Spruce, grade to suit particular purpose and to be straight, square edged, straight grained, surfaced four sides (S4S), and which will retain nails and screws without splitting. Provide fire retardant treatment.

D. Wood Veneers and Lumber: Provide AWI Premium Grade materials and workmanship. For species not listed in the AWS comply with the following:

1. Provide AWS Lumber Grade Premium and AWS Grade AA Veneer, book-matched, minimum 6-inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.

2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids

from the same distributor, and from the same flitches and solids sources to the greatest extent possible.

E. Lumber: AWS Section 3 with the following requirements:

1. Hardwood for Transparent Finish: Premium Grade, select species and cut to match adjoining veneers, unless otherwise shown or specified, and free from cat's eyes, bird's eyes, burls, curls, or cross grains.

2. Hardwood for Opaque Finish: Any hardwood which, when finished, will not show any grain, imperfection or other surface defects when used with the opaque finish specified.

F. Plywood: AWS Section 4; veneer core, particleboard or plywood core unless otherwise specified, and with the following requirements:

1. Hardwood: Premium Grade, face veneers as shown or specified.

2. Particleboard: Premium Grade, fire retardant for wall paneling only equal to Duraflake FR and Duraflake for cabinets. Particleboard shall be certified to meet EPP CPA 3-08 formaldehyde emission limit of 0.18 ppm, and contain no added formaldehyde resins.

3. Medium-Density Fiberboard (MDF): Conforming to ANSI A208.2, Grade 130 and ANSI MR10 moisture-resistant properties on 5/8" or thicker board. MDF shall be certified to meet EPP CPA 3-08 formaldehyde emission limit of 0.21 ppm, and contain no added formaldehyde resins.

4. Edges: Banded with hardwood in accordance with Premium Grade Standards.

G. Wood Species and Cut for Transparent Finish: Quarter sliced/sawn, species as selected by the Architect.

1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.

H. Veneer Matching Requirements:

1. Matching Between Adjacent Veneer Leaves: Book match and architectural end match.

2. Matching Within Individual Panel Faces: Balance and Center Match.

3. Method of Matching Panels: Blueprint-matched panels and components.

I. Finishing (Wood)

1. Transparent Finish

a. AWI Factory Finish System "Conversion Varnish, System 5, Transparent."
b. AWI Premium Grade.
c. Stain: As selected by the Architect.
d. Degree of Sheen: Dull satin.

2. Opaque Finish

a. AWI Factory Finish System "Conversion Varnish, System 5, Opaque."

b. AWI Premium Grade.
c. Degree of Sheen: Satin.
d. No grain to show.

2.3 COLORED THOUGH PLASTIC LAMINATE

A. Face Sheets: Colorcore 2 or approved equal. Color, pattern, and finish as selected by the Architect.

B. Backing Sheets: Non-decorative, high-pressure plastic laminate, NEMA LD3, Grade BK20, 0.02" thick.

C. Edges: Finish with plastic laminate to match face and applied before face sheets are applied, unless otherwise shown or specified.

2.4 LINOLEUM SURFACING

A. Provide homogeneous linoleum surface material with through color, "Bulletin Board" by Forbo Flooring Systems, or approved equal.

2.5 METAL

A. Steel

1. Structural Steel Shapes and Plates: ASTM A 36.

2. Hot-Rolled Carbon Steel Sheets: Commercial quality, ASTM A 569, may be used for concealed parts only. Galvanize sheets for planters.

B. Primer for Unexposed Metal: Zinc chromate primer.

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners

1. Wood Screws: FS FF-S-111, type, size, material and finish as required for the condition of use.

2. Nails: FS FF-N-105, type, size, material and finish as required for the condition of use.

3. Anchors: Type, size, material and finish as required for the condition of use.

4. Staples: Upholstery type staples of sufficient strength to hold fabric taut in place without sagging.

B. Adhesives

1. For Laminating Plastic Laminate Surfaces: Urea resin, Type II, as recommended by fabricator.

2. For All Other Uses: Polyvinyl acetate resin emulsion or other type as recommended by the fabricator.

2.7 CABINETS WITH THROUGH PLASTIC LAMINATE FINISH

A. General

1. Fabricate all cabinetry and millwork to the "Premium Grade" standards of the AWS, Section 10.

2. Face construction of cabinets shall be "Flush Overlay."

3. Provide 3/4" thick doors, drawer fronts and fixed panels (including thickness of plastic) except where required to be thicker by Standards; and provide flush units.

4. Provide dust panels of 1/4" thick plywood or tempered hardboard above compartments and drawers, except where located directly below countertops.

5. Exposed Edges: Plastic laminate matching exposed panel surfaces. Ease exposed edge of overlap sheet.

B. Plastic Laminate

1. Plastic Laminate for Horizontal Surfaces: 0.050" thick, general purpose type (high pressure).

2. Plastic Laminate for External Vertical Surfaces: 0.028" thick, general purpose type (high pressure).

3. Plastic Laminate for Post Forming: 0.042" thick, post forming (high pressure).

4. Plastic Laminate for Cabinet Linings: 0.020" thick, cabinet liner (high pressure).

5. Plastic Laminate for Concealed Panel Backing: 0.020" thick, backer type (high pressure).

6. Plastic Laminate Colors and Patterns: As selected by the Architect from manufacturer's standard satin finish products.

C. Shop Assembly: All work shall be shop assembled. Work that is too large for entrance into the use area shall be fabricated in attachable sections with provisions for reconnection in the using space.

D. Material Thicknesses: See drawings for general material thicknesses. Minimum thickness of solid lumber for web frames, trim, bases, etc., shall be 3/4". Minimum thickness of plywood and particleboard shall be 3/4".

E. Sizes: See drawings for woodwork sizes required. The manufacturer shall check field dimensions and verify all openings and actual field conditions prior to fabrication of work.

F. Manufacturer is responsible for rigidity and structural stability.

2.8 PLASTIC LAMINATE COUNTERTOPS AND VANITIES

A. Grade: Same as AWI grade required for cabinet work; plastic laminate finish.

B. Construction

1. Provide back-splash and end-splash, where detailed; top-mounted square butt joint, fully covered with matching plastic laminate, eased edges.

2. Exposed Counter Edges: Plastic laminate matching surface, except as otherwise indicated. Ease exposed edges of overlap sheet.

3. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements, but provide internal corners of 1/8" minimum radius. Smooth saw cut and ease edges.

4. Seal cut edges of counter at openings for sinks and other "wet" equipment, using waterproofing compound recommended by plastic manufacturer and compatible with laminating adhesive.

2.9 BUILT-IN CABINETS, WOODWORK WITH WOOD VENEER FINISH

A. Construction: Details of cabinet and woodwork construction shall conform to design as detailed on the drawings and shall be constructed in accordance with AWS Section 10, Premium Grade.

B. Finishing: All work shall be factory pre-finished. No field finishing will be permitted, except minor retouching that is necessary after installation to leave work in perfect condition. Field touch-up shall be accomplished using the same finishes as originally applied at the factory. All finishes shall be free from runs, sags and other visual defects. All wood shall be thoroughly hand smoothed and hand sanded to remove all traces of machine and tool marks. All steel or other metal components shall be deburred, thoroughly cleaned and degreased prior to finishing. Requirements for surface preparation shall be in accordance with AWI Standards specified. Surfaces shall be finished as follows:

1. Wood Species and Cut for Exposed Surfaces: As specified hereinabove.

   a. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
   b. Matching of Veneer Leaves: Book match.
   c. Vertical Matching of Veneer Leaves: End match.
   d. Veneer Matching within Panel Face: Running match.
   e. Veneer Matching within Room: Provide casework veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

2. Semi-Exposed Surfaces: Provide surface materials indicated below:

   a. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
   b. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
   c. Drawer Bottoms: Hardwood plywood.

3. All wood veneer surfaces shall be given transparent finish as specified herein.

4. Backing Veneer: Provide backing veneer, of same thickness and strength as face veneer for balanced construction, where plywood surface not exposed, not semi-exposed, or not to be finished. Note that interior surface of cabinets, closets, are to be finished.

C. Edge Banding: All visible edges of case and body members fabricated from plywood shall be banded. Transparent finished wood veneer panels shall be banded with wood species to match face veneers.

2.10 HARDWARE

A. Architectural Woodwork Hardware: Provide the following items, or their approved equal, as required:

1. Hinges: Hafele concealed hinges.

2. Catches: Magnetic; top and bottom.

3. Pulls: Selected by the Architect.

4. Locks: Directed by the Architect.

5. Drawer Slides

a. 24" Maximum Width: Accuride, Model 7434, full extension, 100 lb. capacity.
b. 16" Maximum Width, Easy Close: Accuride Model 3832C, full extension, 100 lb. capacity.

6. Shelf Supports: Pin and grommet system equal to No. 282.01.701 pin and 282.50.704 grommet made by Hafele.

7. Finish: Satin stainless steel.

B. Closet Hardware: Oval wardrobe rails, chrome-plated steel with center bracket and wall-support brackets made by Hafele, or approved equal.

2.11 SOLID SURFACING MATERIAL COUNTERTOPS

A. Engineered Quartz Surfacing: Provide 1-1/4" thick quartz stone surfacing as manufactured by CaesarStone Quartz Surfacing, or approved equal.

1. Color: See Finish Schedule

2. Finish: Polished on all exposed surfaces unless otherwise indicated.

3. Exposed Edges and Corners

a. Edges: Square. Miter joint with 1/8" diameter eased edge profile at countertop fascia.
b. Outside Corners: Square.

4. Anchors and Fastening Devices: Fabricate from AISI Type 304 stainless steel, No 4 finish.

5. Fire Test Results (ASTM E 84):

a. Flame Spread Index: Class A Rating (20).
b. Smoke Developed Index: Class A Rating (110).

2.12 FABRICATION - GENERAL

A. Provide lumber framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.

B. Do all fabrication from field measurement with provision for scribing as required to meet built-in conditions.

C. Coordinate the work of this Section with the work of other trades.

D. Fabricate units in largest practicable sections. Assemble in the shop for trial fit, disassemble for shipment and reassemble with concealed fasteners.

E. Maintain relative humidity and temperature during fabrication, storage and finishing operations matching that of the areas of installation.

F. Details indicate the required type and quality of construction. Modifications to conform to manufacturer's standards will be considered provided that they comply with the Contract Documents and maintain the profiles shown, subject to acceptance by the Architect.

G. Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

H. Factory finish all items where possible. Defer final touch-up, cleaning and polishing until after delivery and installation.

I. Comply with AWI, Premium Grade, for sanding, filling countersunk fasteners, back priming and similar preparations for the finishing of architectural woodwork, as applicable to each unit of work.

J. Prepare all countersunk wood screw attachments for wood plugs. Wood plugs shall match surrounding species and grain direction; putty filling is not acceptable.

2.13 FABRICATION - SPECIFIC ITEMS

A. Millwork

1. Include all preparations for mechanical, electrical, telephone and plumbing work required.

2. Provide cabinet hardware for millwork as shown.

3. Provide dust panels in body webs and between drawer units.

4. Provide wood veneers for exposed surfaces as specified herein before.

5. Hollow core doors will not be permitted.

6. Provide matching veneers for edge treatments of case body members where transparent finishes are indicated or specified.

7. Provide drawers with slides as specified. Drawers shall not rest on web body frames.

8. Provide wood veneers for transparent finish, of matching and continuing grain, for drawer and door edges.

B. Closet and Storage Shelving

1. Provide closet and storage shelving in accordance with AWI, Custom Grade, unless otherwise shown or specified.

2. Exposed edges shall have hardwood edge bands.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where architectural woodwork is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 FRAMING

A. Use specified framing lumber, sizes and spacing as indicated on drawings and as required to support loads.

B. Framing shall be cut square on bearings, closely fitted, accurately set to required lines and levels, rigidly secured in place at bearings and connection with nails, lag screws and/or bolts as required by conditions.

3.3 GROUNDS, BLOCKING, NAILERS, AND FURRING

A. Provide all wood grounds, blocking, nailers, furring, and the like for work of this Section, where shown and where required, dressed to size indicated or required to suit the condition. Install grounds, blocking, nailers, furring, etc., rigidly, in proper alignment, trued with a long straight edge.

3.4 ROUGH HARDWARE

A. Provide all rough hardware, such as nails, screws, bolts, anchors, hangers, clips and similar items. Hardware shall be of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner. Use galvanized hardware at exterior walls, and at other locations where subject to moisture or where water will be present.

B. Secure wood to concrete and to solid masonry with countersunk bolts in expansion sleeves or other approved manner, to steel with countersunk bolts, to hollow masonry and to drywall with heavy duty countersunk toggle bolts. Space fastenings not more than sixteen (16) inches apart. Hardened cut nails, power-driven fastenings, or other suitable devices may be used where approved by the Architect.

C. Connections and fastenings shall be made in such manner as will compensate for swelling and shrinkage and shall permit the work to remain permanently in place without any splitting or opening of joints.

3.5 INSTALLATION OF CABINET FINISH HARDWARE

A. All items of finish hardware furnished under this Section shall be carefully fitted and secured in place as part of the work of this Section. Locations and positioning of hardware shall be subject to the Architect's approval. Care shall be taken not to mar or damage hardware, or other work. Install doors plumb and true. Hardware shall be fitted to assure operation without forcing.

B. After preliminary fitting of hardware, the Contractor shall remove trim for painting and finishing work; after which he shall reinstall the hardware in a permanent manner.

C. Upon completion of the work, before final acceptance of the building by the Owner, the Contractor shall, in the presence of the Architect, show that all hardware is in satisfactory working order; fit all keys in their respective locks and, upon acceptance of the work, shall tag and deliver all keys to the Architect and Owner.

D. When directed by the Owner, at any time during the first year after the completion of the Contract, the Contractor shall return to the building and adjust and refit the work and hardware, and leave such items in satisfactory working order.

3.6 GENERAL INSTALLATION

A. Wall anchorage and general installation procedures for cabinetry work shall conform to AWS Section 10, Article entitled "EXECUTION," Sub-Article 6.1, with all related sub-paragraphs.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops), and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offset in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.

3.7 CLOSET AND STORAGE SHELVING

A. Provide closet and storage shelving at the locations shown. Provide hang rods where shown. Set adjustable center hangers.

3.8 CABINET WORK AND MILLWORK

A. General

1. Materials and workmanship shall conform to the Quality Standards of the Architectural Woodwork Institute specified herein and to the drawings.

2. Cabinet work and millwork shall be performed by an experienced cabinet work and millwork company, having craftsmen skilled in their trade.

3. Fabricate all cabinet work and millwork completely in the shop, in complete and/or as large units as practical, leaving only fitting, assembly, installation and a minimum of fabrication and finishing to be done at the building. Assembled work shall be rigidly secured and permanently fastened together with concealed fasteners.

4. Afford Architect every facility for inspection of work at shop or mill at such times as the Architect may select.

5. As far as practicable, use concealed fastenings for joining and assembling the work. Where this is impossible, the means of securing shall be placed in inconspicuous places and methods of joining and assembling submitted for Architect's approval prior to fabrication.

6. Mill all finish wood accurately to detail, with clean cut moldings, profiles and lines, machined, sanded smooth, housed, jointed, blocked, put together in the best manner, with provision for swelling and shrinkage, and to assure the work remaining in place without warping, splitting or opening of joints.

7. Cut trim to dimensions and profiles shown, from solid stock.

8. Make all trim and the like in single lengths wherever possible; joints mitered, glued and splined. Continuous members shall have tight flush joints, doweled or splined and glued.

9. Make all joints hairline tight, fitted accurately and joined with hardwood splines or dowels, glued together, or by other method approved by Architect. Use screws, not nails, for fastenings.

10. Gluing shall, where practicable, be by the hot plate press method and glued surfaces shall be in close contact throughout. Glue stains on finished work will not be permitted.

11. Cover surface fastenings, where permitted, with matching wood plugs or wood putty. Finish exposed edges of plywood with matching solid stock. Lock miter external corners; tongue and groove internal corners to allow for contraction and expansion.

12. Machine sand with grain, finish with hand sanding, leave exposed surfaces free from machine or tool marks that will show through the finish.

13. Work which adjoins drywall, concrete, or other finish shall be fitted and scribed in a careful manner and ample allowance shall be given for cutting and scribing.

14. Erect work true to lines, levels and dimensions, square, aligned and plumb, securely and rigidly fastened in place.

B. Cabinet Work: Provide all items of cabinet work indicated on drawings and as herein specified.

1. Tops, sides, backs, bottoms, dividers, shelves, fronts, doors and drawer fronts shall be of plywood or flakeboard core, with the specified wood veneer or plastic laminate as indicated on drawings.

2. Drawer sides and backs shall be 1/2" thick solid clear selected white birch, suitable for clear finish. Drawer bottom shall be 3/8" thick plywood with clear selected white birch veneers, suitable for clear finish.

3. Cabinet doors and drawers shall be flush mounted.

4. Adjustable shelves in cabinets shall have grommets spaced 2" o.c.

5. Fixed shelves shall be dadoed into side supports and glued.

6. Shelves shall be 3/4" thick for spans up to 30"; for spans in excess of 30" to 48" shelves shall be 1" thick.

7. All cabinets shall have closed top, sides, bottom, and back with veneers to match face work. Cabinets to fit accurately into indicated locations; scribe moldings permitted only where indicated.

8. Countertops, counters, counter fronts, shelves, etc., indicated on drawings to have plastic laminate, shall have plastic laminate shop applied to 3/4" thick core, with plastic laminate backing sheet on underside or back of countertops, counters and shelves. Plastic laminate shall be pressure laminated to core with laminate at external corners. Provide concealed wood framing to support plastic laminate counters, securely fastened to wall and to underside of counters.

C. Countertops shall be installed to support a minimum concentrated live load of 150 lbs. acting downward at mid span at outer edge of counter without causing deformation and damage.

3.9 PAINTING AND FINISHING

A. General: All painting and finishing work of this Section shall be shop applied, unless otherwise noted, as specified below. All painting and finishing shall match approved samples. Field finish painting, where specified below, shall be by painting Subcontractor, as specified for in Painting Section.

B. Back-Painting: All work of this Section in contact with concrete or masonry or other moisture areas and all concealed surfaces of cabinet and millwork, shall be back-painted with one (1) coat of oil-based paint prior to installation, shop applied where practicable.

C. Field Touch-Up: Field touch-up shall be the responsibility of the installing Subcontractor and shall include the filling and touch-up of exposed job made nail or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleaning up of the finished surfaces.

3.10 CLEAN UP AND PROTECTION

A. Clean Up: At regular intervals during the course of the work, all debris and excess material shall be cleaned up and removed from the site. Upon completion of installation, clean all spaces of debris caused by woodwork installation.

B. Protection: Protect all woodwork from marring, defacement of other damage until final completion and acceptance of the project by the Owner. Repair or replace all defective units prior to final inspection as directed by the Architect. Any units that cannot be satisfactorily repaired in the opinion of the Architect shall be replaced with new units of same original design, at no additional cost to the Owner.

END OF SECTION

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sheet membrane waterproofing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Sheet membrane waterproofing for foundation wall surfaces.

2. Sheet membrane waterproofing for under-slab conditions.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Earthwork - Section 312000.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Approximately 2 weeks prior to scheduled commencement of waterproofing installation, meet at Project site with Waterproofing Installer; preparer of substrate to receive waterproofing; installers of other work in and around waterproofing that must precede, follow, or penetrate waterproofing (including Mechanical and Electrical Installers as applicable); Architect; Owner; and waterproofing manufacturer's representative to review materials, procedures, schedules, and other requirements and conditions related to installing waterproofing.

B. Qualifications of Subcontractors

1. Subcontractors: All work of this Section shall be performed by a subcontractor who is approved by the manufacturer of the waterproofing material.

2. Qualifications of Subcontractors: Subcontractors shall submit evidence of being bona fide waterproofing subcontractors, for a period of not less than five (5) years, and that they are approved by the manufacturer of the waterproofing material for the installation of the manufacturer’s material in accordance with the requirements of this Section.

   a. Subcontractor shall submit a letter from manufacturer of waterproofing material stating that subcontractor is approved by the manufacturer for the application of the waterproofing systems specified and accepted for use on the Project.
   b. Letter shall certify that the subcontractor has previously and satisfactorily applied the waterproofing systems specified herein on jobs of similar size and scope, under manufacturer’s supervision.
   c. Letter shall be on manufacturer’s letterhead and shall be signed by an officer of the company, not by a local sales representative.

C. Manufacturer's Representative/Contractor's Certification

1. Representative of the waterproofing material manufacturer shall be required to provide field instructions and supervision for the installation of the waterproofing systems at the start of the work of this Section.

2. The manufacturer's representative shall be required to make sure that the workmen for waterproofing systems on the site of the Project are fully instructed and trained in the handling and application of all the materials and shall see that all the materials are correctly installed.

3. Upon completion of the Installation, submit to the Architect written certification that the representative of the manufacturer of the waterproofing material has supervised the work of this Section and that all materials were correctly installed.

1.5 SUBMITTALS

A. Shop Drawings: Typical installation details, showing details at flashings, at terminations, at joints, at intersection of horizontal and vertical surfaces, and at penetrations in membrane system.

B. Samples - Submit

1. Membrane, 6" x 6" samples of each membrane.

2. 6" x 6" sample of flashing.

3. 6" x 6" sample of drainage board.

C. Manufacturer's Literature: Submit manufacturer's technical, safety data sheets, and installation literature for all materials of this Section. Submit Independent Test data indicating that membrane meets properties specified herein.

D. General Contractor's Certification: Submit per Article 1.4.

1.6 STORAGE OF MATERIALS

A. All materials shall be stored in their original tightly sealed containers or unopened packages; shall be clearly labeled with the manufacturer's name, brand name and number, and batch number of the material with expiration date where appropriate.

B. Materials shall be stored in a neat and safe manner so as not to exceed the allowable live load of the storage area.

C. Material shall be stored out of the weather in a clean, dry area.

D. Liquid materials, such as adhesives, thinners, and primers, shall be stored in areas away from sparks, open flames, and excessive heat.

1.7 JOB CONDITIONS

A. No application of waterproofing shall commence or proceed during inclement weather, or the threat of imminent precipitation.

B. All surfaces to receive the system shall be thoroughly dry and free of dew or frost.

C. Materials shall be stored until time of mixing at temperatures above 60 deg. F. to maintain a consistency suitable for mixing. Do no work below 40 deg. F.

D. Prior to and during application, all dirt and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air, or similar methods.

E. Surfaces not designated to receive the system shall be properly masked or otherwise protected against accidental spillage or application of the material to those areas.

1.8 PROTECTION

A. Against Loads: Protect work of this Section against concentrated loads and any other loads or equipment that would damage the materials or work.

B. Against Traffic: Do not permit traffic on horizontally installed work of this Section, except for workmen doing the work, during the installation, and after the installation until membrane systems are covered with protective boards or with the specified finishing materials.

C. Against Damage: Protect vertically installed work of this section from damage by reinforcing and placement.

1. Take and maintain necessary preventive measures to protect work of this Section from damage until Project is accepted.

2. Rejection of Damaged Work

a. Damaged materials or work will be rejected.
b. Rejected materials or work must be immediately removed and replaced with new materials.

1.9 FIELD QUALITY CONTROL

A. Construction Traffic:

1. Limit construction traffic over completed membrane.

2. General Contractor shall provide 1/2 in. plywood protection layer, where construction traffic is unavoidable.

B. Inform Architect in writing on a daily basis of any of the following events. State specific location of each occurrence.

1. Buckling to the Waterproofing and other deformations as a result of ground water events.

2. Leakage through the finished waterproofing installation.

3. Damage by other trades.

C. Provide Manufacturer's Representative's report (prior to backfill) stating that the waterproofing has been inspected and is acceptable and eligible for manufacturer's warranty.

1.10 WARRANTY

A. The manufacturer of the waterproofing system executed under this Section warrants the waterproofing system to be watertight and free from defects in materials and workmanship for a period of ten (10) years from date of acceptance of this Contract, and that he, agrees to promptly make repairs or replace defective waterproofing materials during the warranty period.

B. Contractor's Two-Year Workmanship Warranty: Provide a written guarantee for all work of this Section, stating that if, within two years after the Date of Substantial Completion of the Work, any of the work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so. The guarantee shall state that the Contractor shall bear all costs incurred by the Owner, including reasonable attorney's fees, to enforce compliance with the obligations of this Guarantee, and will replace any material or system that requires repeated maintenance or repair to function effectively. The obligation of this Guarantee shall run directly to the Owner and may be enforced by the Owner against the Contractor, shall survive the termination of the Contract and shall not be limited by Conditions other than this Contract.

PART 2 PRODUCTS

2.1 WATERPROOFING MEMBRANE

A. Trade names used herein for membrane waterproofing are those of GCP Applied Technologies. Other acceptable manufacturers will be Carlisle Coatings and Waterproofing (CCW), Henry Company or approved equal.

B. For foundation walls, provide "Bituthene 4000" sheet waterproofing membrane, 60 mils thick and "Liquid Membrane," 60 mils thick, for flashing, as manufactured by GCP Applied Technologies or approved equal.

C. At under-slab conditions, provide adhesive coated HDPE Composite Sheet "Preprufe 300R Plus" system by GCP Applied Technologies or approved equal.

1. HDPE membrane or reinforced TPO membrane shall have a protective layer to protect the membrane from the weather and U.V. for up to 56 days before casting concrete against it.

D. Primer/Conditioner: "Bituthene 4000" latex/water-based primer specifically formulated to provide adhesion of Bituthene Waterproofing Membranes.

1. If water-based primer does not provide sufficient adhesion to substrate, substitute Bituthane Primer B-2 solvent-based primer.

E. Bituthene Elastomeric Mastic: Rubberized asphalt base mastic.

F. Tape: Double sided synthetic adhesive tape equal to "Preprufe LT" and "HC."

G. Protection Board: 1/4" thick semi-rigid protection board, "Bituthene Asphaltic Hardboard."

H. Bituthene Liquid Membrane: Two-component 100% solids trowel grade asphalt modified urethane.

I. Drainage Board/Composite: Prefabricated dimpled polystyrene drainage core with a non-woven filter fabric on one side and a polymer film on the reverse side.

1. Vertical Applications

   a. "Hydroduct 220" by GCP Applied Technologies.
   b. Or approved equal.

2. Horizontal Applications

   a. "Hydroduct 660" by GCP Applied Technologies.
   b. Or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where membrane waterproofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work. Starting of work implies acceptance of substrate.

3.2 PREPARATION OF SURFACES TO RECEIVE WATERPROOFING

A. Conform to the requirements of specified manufacturer.

B. Earth or crushed stone substrates shall be compacted to produce an even, sound substrate. Loose aggregate, sharp protrusions and standing water shall be removed.

3.3 INSTALLATION OF FOUNDATION WALL WATERPROOFING

A. General: Conform to recommendations and published specifications of the manufacturer' including environmental requirements and preparation requirements to receive waterproofing.

B. Foundation Walls

1. General: The membrane, when in place must withstand a minimum static ground water pressure of 150 feet.

2. Priming: Application of primer shall be limited to what can be covered with Bituthene Waterproofing Membrane in a given work day. Primed areas not covered by membrane during the work day will be reprimed. Apply primer by spray, roller or brush at a rate of 250 - 350 sq. ft. per gallon. Roller shall be natural material such as lamb's wool, having a nap of approximately one inch. Primer shall be applied to a clean, dry, frost-free and dust-free surface. Sufficient primer must be used on the day surface to condition it to a dust-free state suitable for the application of Bituthene Waterproofing Membranes.

   a. Bituthene 4000 Surface Conditioner should not be applied below 25 deg. F. on vertical surfaces. Allow primer to dry 30 minutes. Conditioner is considered dry when the substrate returns to its original color.
   b. Re-prime areas that become dusty or dirty prior to membrane installation.

3. Membrane Installation: Apply Bituthene Waterproofing Membrane vertically in sections of 8' in length or less. On higher walls apply two or more sections with the upper overlapping the lower by a least 2-1/2". Press all membrane in place with heavy hand pressure or rollers during application.

4. Sealing Edges: Bituthene Waterproofing Membrane shall be applied over the edge of the slab or over the top of the foundation or parapet wall. If the membranes are terminated on the vertical surface, a reglet or counter flashing may be used or the membrane may be terminated directly on the vertical surface by pressing very firmly to the wall. Press edges with a metal or hardwood tool such as a hammer or knife handle. Apply a troweled bead of Bituthene Mastic to all vertical and horizontal terminations. Bituthene Liquid Membrane can be used as an alternative method at the General Contractor's option.

5. Sealing Seams: All edges and end seams must be overlapped at least 2-1/2". Apply succeeding sheets with a minimum 2-1/2" overlap and stagger end laps. Roll or press the entire membrane firmly and completely as soon as possible. Patch misaligned or inadequately lapped seams with Bituthene Membrane. Slit any fish mouths, overlap the flaps, and repair with a patch of Bituthene and press or roll in place. The edges of the patch shall be sealed with a troweling of mastic. Laps within 12" of all corners shall be sealed with a troweling of mastic.

6. Corner Forming: Outside corners must be free of sharp edges. Inside corners shall receive a fillet formed with Liquid Membrane, latex modified cement mortar equal to Daraweld C made by Grace mixed with cement mortar or epoxy mortar. Do not use fiber or wood cants. One of two methods may be used for treating corners at the General Contractor's option:

    a. Apply Bituthene Liquid Membrane 6" in each direction from the corner and form a fillet with a minimum 3/4" face.
    b. Install an 11" minimum strip of Bituthene Membrane centered on the corner. Install Bituthene Membrane over the treated inside and outside corners.

7. Over waterproofing, apply drainage composite board by adhering board to cured membrane using tape or adhesive per manufacturer’s recommendations; lap all edges 4” and conform to the following:

    a. Install drainage layer directly over the membrane. Start at the low points on the wall and shingle all laps to the flow of water.
    b. Splice drainage panels together by butting longitudinal edges of adjacent sheets and peeling back fabric to expose the cores of the panels. Install precut "lock strips" consisting of 4 dimple x 5 dimple sections of the drainage panel centered on the joint between the panels and spaced every 10 dimples along the length of the joint. Snap dimples of lock strip to dimples of each panel and reattach fabric over the panel joint.
    c. Cut the core of the drainage panels around penetrations and cut an 'X' in the filter fabric and tape the fabric to the sides of the penetration.
    d. Cover all terminal edges of the drainage composite with an integral fabric flap by tucking the fabric around the edge of the core and adhering the fabric to the bottom of the core.

3.4 INSTALLATION OF BELOW-GRADE, UNDERSLAB WATERPROOFING

A. General: Install adhesive coated HDPE composite sheet according to waterproofing manufacturer's written instructions.

B. Preparation

1. Surfaces to receive blind side membranes must be smooth and sound, with no gaps or voids in excess of 1/2 in. Earth and stone substrates must be compacted to produce an even, solid substrate. If required by membrane manufacturer, provide an additional layer of underlayment protection board over sharp or angular stone substrates. Surfaces to receive waterproofing shall be thoroughly dry and free of moisture.

2. General: Comply with manufacturer's instructions for preparing surface including joint or crack treatment.

3. Apply primer to substrate surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area that will be covered by waterproofing membrane in same working day. Reprime areas not covered by waterproofing membrane within 24 hrs.

C. Underslab Applications

1. Apply Hydroduct 660 drainage composite board as recommended by manufacturer over the compacted sub-grade.

2. Apply the membrane over the drainage composite board with the HDPE side facing the drainage composite board and the treated white coating surface facing the concrete to be poured. The membrane may be installed at any convenient length. Apply succeeding sheets by overlapping previous sheets 3" along the self-adhesive edge of the membrane. Remove the silicone coated release liner covering the membrane and roll the side lap to assure a tight seal.

3.5 SEAM REINFORCEMENT FOR HDPE COMPOSITE SHEETS ONLY

A. Provide a 6 in. strip of modified bituminous sheet membrane (Bituthene 4000) centered behind all laps.

B. At locations where a salvage edge is not present and at end laps, lap sheets 6 in., apply a 1/8 in. thick by 6 in. wide application of liquid membrane between sheets, to provide a 6 in. wide seal.

C. Integration of old onto new pre-applied sheet membrane.

1. Integration of Sheet Membrane onto Sheet Membrane that has been installed in excess of 30 days prior

a. Lap sheets 12 in., apply a 1/8 in. thick by 12 in. wide application of fluid membrane between sheets, to provide a 12 in. wide seal at this location.
b. Install Waterproofing Tape centered at edge of lap and roll firmly into place with an approved roller.
c. Install additional Waterproofing Tape to cover white film that has been installed over 30 days prior.

2. Repair of pre-applied sheet membrane

    a. Scratch on white coating exposing underlying black surface of Sheet Membrane. Install Waterproofing Tape at areas where the white coating of the membrane is damaged, including boot scuff marks and abrasions by rebar.
    b. Damage or Puncture of Sheet Membrane: Install Patch of short Membrane set in Liquid Membrane. Patch must extend 3 in. in every direction around extent of damaged area. Install Waterproofing Tape centered over the edge of the patch. If the damaged area does not have 5 in. of sound material around it, inject Liquid Membrane into puncture until Liquid Membrane backs out, and proceed with patch as space allows.

3.6 CLEAN-UP

A. Upon completion of the waterproofing system, the General Contractor shall remove all equipment, material and debris from the work and storage area, and leave those areas in an undamaged and acceptable condition.

END OF SECTION

SECTION 071616 - CRYSTALLINE WATERPROOFING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the crystalline waterproofing as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Crystalline waterproofing system for interior surfaces of concrete pits and trenches, including elevator pits.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing details at terminations, at joints, at intersection of horizontal and vertical surfaces, and at penetrations in waterproofing system. Provide project-specific details showing crack treatment and inside/outside corners details as appropriate.

B. Product Data: Submit manufacturer's technical information and installation instructions for all materials of this Section.

C. Contractor's Certification: Submit per Article 1.6.

D. Subcontractor's Qualifications: Submit per Article 1.7.

1.4 STORAGE OF MATERIALS

A. All materials shall be stored in their original tightly sealed containers or unopened packages; shall be clearly labeled with the manufacturer's name, brand name and number, and batch number of the material where appropriate.

B. Materials shall be stored in a neat and safe manner so as not to exceed the allowable live load of the storage area.

C. Material shall be stored out of the weather in a clean, dry area.

1.5 MANUFACTURER'S REPRESENTATIVE

A. Contractor shall require representative of manufacturer of the waterproofing material to provide field instructions and supervision of the installation of the complete waterproofing system.

B. Contractor shall require the manufacturer's representative to make sure that the subcontractor's workmen are fully instructed and trained in the handling and application of all the materials and shall see that all the materials are correctly installed.

C. Upon completion of the installation, the Contractor shall submit to the Architect a written certification that the representative of the manufacturer of the waterproofing material has supervised the work of this Section and that all materials are correctly installed.

1.6 QUALIFICATIONS OF SUBCONTRACTORS

A. Subcontractors: All work of this Section shall be performed by a subcontractor who is approved by the manufacturer of the waterproofing material.

B. Qualifications of Subcontractors: Subcontractors, in order to obtain Architect's acceptance for doing work of this Section, shall submit evidence of being bona fide waterproofing subcontractors, and that they are approved by the manufacturers of the waterproofing material for the installation of their material in accordance with the requirements of this Section. Subcontractor shall submit letter from manufacturer of waterproofing material stating that the subcontractor is approved by the manufacturer for the application of the waterproofing system specified for the Project. Letter shall certify that the subcontractor has satisfactorily applied the waterproofing system specified herein under manufacturer's supervision. Letter shall be on manufacturer's letterhead and shall be signed by an officer of the company.

1.7 WARRANTY

A. The Contractor and manufacturer shall jointly warrant the waterproofing system executed under this Section to be watertight and free from defects in materials and workmanship for a period of ten (10) year from date of acceptance of this Contract, and that he, at his own expense, repair and/or replace all other work which may be damaged as a result of such defective work, and which becomes defective during the warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

A. Waterproofing materials shall be a cement bond compound, free from chloride and iron oxide, which waterproofs by crystalline growth through the capillary tracts and shrinkage cracks in the concrete substrate equal to "Aqua-Fin IC," as manufactured by Aqua-Fin Inc., or equal made by Tamms Industries, Xypex Chemical Corp. or Anti-Hydro Co.

B. Accessory Materials: Provide patching compound, plugging compound, and polymer admixture for protective topping.

C. Mixing Water: Potable.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where crystalline waterproofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Temperature Requirements: Surrounding temperatures shall be a minimum thirty-five (35) degrees F. for forty-eight (48) hours before, during and after installation.

B. Preparation of Surfaces

1. Surfaces to be waterproofed shall be clean and free of form scale, mould, laitance, oil, form release agents, curing compounds, hardeners, and any other materials likely to affect the bond penetration or performance of the waterproofing materials.

2. Materials shall not be applied to frozen or frosted surfaces, nor during rain or snow.

3. The presence of moisture in the concrete substrates is essential at the time of the waterproofing application. Should this not be the case, soak thoroughly all surfaces with water a day prior to the waterproofing and remove all free laying water.

4. All cracks in the concrete structure exceeding .01" in width and construction joints which have not been treated before with crystalline waterproofing, shall be routed out to a minimum depth of 3/4".

5. Areas that have become dirty and concrete pours which have resulted in an extremely smooth surface shall be acid etched or, at the Contractor's option, may be sand blasted. Surfaces to be acid etched shall be dampened with clean water. Etching shall be done with a fifteen (15) percent hydrochloric (muriatic) acid. One gallon of acid should cover about fifty (50) to seventy-nine (79) square feet. Allow the acid to stand at least three (3) minutes and when bubbling ceases, flush off with water immediately. Do not let the acid stay on the surface for a prolonged period. When completed, the surface shall have a finish similar to fine or medium sandpaper. Surfaces which retain a smoothness or dirty condition shall be re-etched until the desired effect is obtained.

6. Fill Form: Tie holes with "Aqua-Fin Mortar" of mortar consistency.

7. Vertical Concrete Surfaces

a. Grind off all fins and other projections.
b. Extremely smooth surfaces must be etched or sand blasted.
c. Form ties with insets shall be removed. Chip back concrete approximately one (1) inch where form ties are without insets.
d. Honeycombed Pockets and Faulty Construction Joints: Rout out all faulty materials back to sound concrete; clean and rinse thoroughly with water all surfaces to be treated; check by rubbing hand over the surfaces. Hand should not become wet.

C. Mixing of Crystalline Waterproofing Materials

1. Slurry Consistency: The crystalline waterproofing materials shall be delivered in powder consistency in original undamaged containers with manufacturer's labels and seals intact.

a. Separate container shall be used for measuring by volume the powdery crystalline waterproofing and the water.
b. Measure two (2) parts of crystalline waterproofing and 0.7 - 0.9 parts of water (depending on water or absorption of concrete).

2. Mortar Consistency for Seal Strips and Coves

    a. Add water to crystalline waterproofing and/or crystalline waterproofing reinforcing proportion 1:2 and/or 1:3 and mix thoroughly until stiff consistency is reached.
    b. Prepare only as much mortar as can be applied within ten (10) minutes.

D. Installation of Crystalline Waterproofing Materials

1. Slurry Application

    a. Concrete surfaces to be treated with crystalline waterproofing shall be moist, not wet.
    b. Crystalline waterproofing slurry coatings shall be applied with a stiff masonry brush or stiff broom and worked into every irregularity of the concrete surfaces.
    c. Prior to the specified final application of crystalline waterproofing slurry coatings on the concrete surface, the following initial applications and repairs to the concrete structure have to be completed.

2. Construction Joints

    a. Construction joints shall receive a slurry coating of crystalline waterproofing 2.5 lbs. per square yard immediately prior to each concrete pour. In areas where inaccessibility is difficult, apply 2.5 lbs. per square yard of crystalline waterproofing by dry sprinkle method immediately prior to the following pour or rout out to a minimum depth of 3/4".
    b. Apply slurry coating of crystalline waterproofing 1.5 lbs. per square yard to routed out areas of cracks and construction joints and fill remaining depth with crystalline waterproofing and crystalline waterproofing reinforcing 1:6 in mortar consistency in two (2) laminating layers after each layer has reached its initial set (approximately 20-30 minutes).

3. Installation of Crystalline Waterproofing Coves (Junction Horizontal Surfaces and Walls): Apply slurry coating of crystalline waterproofing 1.5 - 2.0 lbs. per square yard, six (6) inches in width, and install a cove with crystalline waterproofing and crystalline waterproofing reinforcing 1:3 in mortar consistency.

4. Honeycombed Pockets in Wall Areas: Rout out all faulty materials back to sound concrete. Apply slurry coating of crystalline waterproofing 1.5 lbs. per square yard over routed out area and fill with sand and cement mortar 1:3. If necessary (owing to depth) apply layers of mortar not exceeding 5/8" in thickness after each layer has hardened and repeat crystalline waterproofing slurry coating.

5. Foundation and Pit Walls - Interior Face

    a. Moisture treat vertical concrete surfaces thoroughly one day prior to application. Construction joints and form tie holes shall be filled with crystalline waterproofing and crystalline waterproofing reinforcing 1:6 in mortar consistency.
    b. Apply two (2) slurry coatings on entire surface, consisting of "Aqua-Fin IC" crystalline waterproofing 1.25 lbs. per square yard per coating, to levels and on surfaces indicated. The second coating shall be applied while the first coating is green, normally within an hour or the application of first coating.

6. Concrete Slabs – Pits: Apply Aqua-Fin IC at the rate of 2.5 lbs./sq. yd. in slurry consistency to concrete slab surfaces in one coat.

E. Curing of Crystalline Waterproofing Application

1. Crystalline waterproofing applications while setting shall be protected from rain, frost and from drying out. During extreme hot weather, light water fog spraying may be necessary during time of application.

2. Moisture treat crystalline waterproofing treated areas for minimum period of three (3) days starting the day following the completion of the crystalline waterproofing application with fog water spray. Surfaces shall have moist and later wet appearance for the duration of the curing period.

3. Treated surfaces shall not be exposed to aggressive water, chemicals or acids until the applications have reached full strength (normally after 14 days).

F. Crystalline Waterproofing with Painted Finish: All crystalline waterproofing surfaces to receive paint shall be neutralized with a solution of muriatic acid and water 1:8 (or vinegar salt water solution) after the crystalline waterproofing application has aged for a minimum period of two (2) weeks.

1. Rinse thoroughly with water all treated surfaces.

END OF SECTION

SECTION 071900 - WATER REPELLENTS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the water repellents as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Water repellent coating applied to masonry walls.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Cast Stone: ASTM C 1195.

2. Clay Brick: ASTM C 67.

C. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, installation instructions and general recommendations for water repellents. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Submit sixteen (16) inch square samples of each substrate indicated to receive liquid water repellent, with repellent treatment as specified applied to half of each sample.

1.6 QUALITY ASSURANCE

A. Installer: A firm with not less than three (3) years of successful experience in application of water repellents of types required on substrates similar to those of this project.

1.7 PROJECT CONDITIONS

A. Water and Substrate Conditions: Do not proceed with application of water repellent (except with written recommendation of manufacturer, when ambient temperature is less than fifty (50) degrees F., or when substrate surfaces have cured for less than a period of two (2) months, or when rain or temperatures below forty (40) degrees F. are predicted for a period of twenty-four (24) hours, or earlier than three (3) days after surfaces became wet from rainfall or other moisture sources, or when substrate is frozen, or at surface temperatures of less than forty (40) degrees F.

1.8 WARRANTY

A. Provide written warranty from the product manufacturer stating that materials and workmanship shall be free of defects (no water penetration due to failure of coating) for a period of ten (10) years from date of acceptance of the Project, and the manufacturer shall remedy any defects in the work that occur within this time limit.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.

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. Prime-A-Pell H20; Chemprobe Corp.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where water repellents are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Test Application: Prior to performance of water repellent work, including bulk purchase/delivery of products, prepare a sample application in an unobtrusive location and in a manner acceptable to Architect, for purpose of demonstrating final effect (visual and physical/chemical) of planned installation. Proceed with work only after Architect's acceptance of test application.

B. Clean substrate of substances which might interfere with penetration/adhesion of water repellents. Test for moisture content, to ensure that surface is sufficiently dry.

C. Coordination with Sealants: Delay application of water repellents until installation of sealants has been completed in joints adjoining surfaces to be coated with repellent.

D. Protect adjoining work from spillage or blow over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass where there is possibility of water repellent being deposited on surfaces. Cover live plant materials with drop cloths. Clean water repellent from adjoining surfaces immediately after spillage. Comply with manufacturer's recommendations for cleaning.

3.3 INSTALLATION

A. Apply a heavy saturation spray coating of water repellent on surfaces indicated for treatment using low pressure spray equipment. Comply with manufacturer's instructions and recommendations, using airless spraying procedure unless otherwise indicated.

B. Apply a second saturation spray coating, repeating first application if required by manufacturer to meet warranty requirements. Comply with manufacturer's instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the thermal insulation as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Foundation wall insulation.
2. Cavity-wall insulation.
3. Foil-faced blanket insulation.
4. Closed-cell, spray foam insulation.
5. Spray-foam insulation at gaps around glazing frames, door frames, penetrations, and similar items in exterior wall assemblies for tie-in of air/vapor barrier to frames.
6. Vapor barrier.
7. Attachment devices.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Roof insulation - Division 7.

C. Firestops and Smokeseals - Section 078413.

D. Gypsum Drywall - Section 092900, for acoustical insulation.

E. Earthwork - Division 31.

1.4 SUBMITTALS

A. Submit product data for each type of product indicated, including re-cycled content.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

1.5 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. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.6 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. Deliver materials to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type and brand. Delivered materials shall be identical to approved samples.

C. Store materials under cover in a dry and clean location, off the ground. Remove materials which are damaged or otherwise not suitable for installation and replace with acceptable materials.

D. Take every precaution to prevent the insulation from becoming wet, cover with tarps or other weather/watertight sheet goods.

PART 2 PRODUCTS

2.1 FOUNDATION WALL

A. Provide extruded polystyrene board insulation equal to "Styrofoam" manufactured by Dow Chemical Co., or approved equal made by Owens Corning or PACTIV Building Products, conforming to ASTM C 578, Type IV, with a maximum flame spread and smoke developed indices of 75 and 450 respectively.

B. Insulation shall have an aged R value of not less than 5/inch; shall be 2" thick unless otherwise noted on the drawings.

2.2 CAVITY WALL INSULATION

A. Provide semi-rigid, mineral wool insulation board, "RainBarrier HD" by Thermafiber, "CavityRock DD" by Rockwool or approved equal conforming to ASTM C 612, with maximum flame-spread and smoke-developed indexes of 15 and 0, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Insulation shall comply with NFPA 285.

1. Thickness: 4", unless otherwise indicated.

2. Nominal density of 6 lb./cu. ft., thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

B. Provide extruded polystyrene board insulation equal to Styrofoam "Cavitymate Ultra" manufactured by Dow Chemical Co. or approved equal conforming to ASTM C 578, Type IV with a maximum flame spread and smoke developed indices of 15 and 165 respectively.

1. Boards shall be 16" wide x 96" long; boards shall be 1" thick unless otherwise noted on the drawings.

2. Insulation shall have an aged R value of not less than 5.6/inch.

2.3 BLANKET INSULATION

A. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim Kraft, or foil-scrim polyethylene; as manufactured by Rockwool, or approved equal.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 SPRAY FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: "Icynene MD-C-200" spray-applied, rigid closed-cell polyurethane insulation manufactured by Icynene, or approved equal; 2.2 lb./cu. ft. density material per ASTM D 1622; meets Class 1 requirements of ASTM E 84.

1. R-Value shall be 6.5 per inch per ASTM C 518.

2. Bond strength shall be greater than 100 psf per ASTM E 736.

3. Product shall be Class 1 Class A per ASTM E 84/ UL 723.

4. Product shall be tested in accordance with UBC 26-2 Test Method for the evaluation of Thermal Barriers (ASTM E 119).

5. Product shall pass Full-Scale Corner Test.

6. Product shall have passed the Air Barrier Association of America (ABAA) testing and be an approved air barrier product.

7. Provide manufacturer's written certification that product contains no asbestos.

B. Thermal Barrier: DC315 thermal ignition barrier over spray-applied insulation, or approved equal.

C. NOTE: Ensure that closed-cell spray foam insulation is compatible with spray-applied fireproofing.

D. Spray Insulation at Perimeter of Frames and Penetrations: Provide closed-cell polyurethane foam insulation product to fill gaps, joints, etc. that both seals and insulates, equal to "Great Stuff Professional Foam" as manufactured by the Dow Chemical Co., or approved equal.

2.5 VAPOR RETARDER

A. Polyamide Film Vapor Retarder: Provide "MemBrain" by CertainTeed or approved equal, with maximum permeance rating of 0.1 perm (57 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 20 and 55, respectively, per ASTM E 84.

1. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.6 ACCESSORIES

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place. Provide "Series T TACTOO Insul-Hangers" by AGM Industries, Inc., "Spindle Type" by Gemco, or approved equal.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.030" thick by 2" square.

2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105" in diameter; length to suit depth of insulation indicated.

3. Affix plate with stainless steel staple or screw.

B. Insulation Fastening System at CMU and Concrete: Provide "Ramset Insulfast" system, or approved equal, mechanical fastening system.

C. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.

1. For bonding rigid polystyrene insulation to masonry or concrete, provide adhesive equal to "Foamgrab PS" made by Dacor Products Co. or equal made by ChemRex Inc. or Miracle Adhesives, or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where thermal insulation is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Clean substrates of substances that are harmful to insulation including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

B. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

D. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24" below exterior grade line.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Install pads of adhesive spaced approximately 24" o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.5 INSTALLATION OF BLANKET INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96", support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

a. Exterior Walls: Set units with facing placed toward interior of construction as indicated on Drawings.

3.6 INSTALLATION OF SEMI-RIGID INSULATION FOR FRAMED CONSTRUCTION

A. Install wall insulation with edges closely butted, with joints square, straight and in alignment (no staggered), and with vapor barrier facing on warm side of building, and with exposed faces flush and in the same plane without warp or twist. Cut and fit insulation to closely fit intersecting or penetrating surfaces. Seal joints between insulation, between insulation and intersecting or penetrating surfaces and between insulation and perimeter surfaces with 4" wide

vaporproof aluminum tape applied on the vapor barrier side. Insulation shall be friction fit between furring channels or studs.

3.7 INSTALLATION OF BOARD INSULATION FOR CONCRETE AND CMU SUBSTRATES

A. Install board insulation on concrete substrates by insulation fastening system specified above at fastener rate per insulation manufacturer's requirements.

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.

3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.8 INSTALLATION OF SPRAY FOAM INSULATION

A. Apply self-supported, spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it flush with face of studs by using method recommended by insulation manufacturer.

3.9 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 072180 - FLUID-APPLIED THERMAL BREAK

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the fluid-applied thermal break work, including primer, insulating coating and top coat, as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Structural Steel - Section 052100.

B. Miscellaneous Metals - Section 055000.

1.4 SYSTEM DESCRIPTION

A. The liquid-applied thermal acrylic material shall be applied at the required thickness to provide the required R-Value of R-0.10 to R-4. In no case shall the thickness be less than that required to achieve the R-value required and K-value of 0.035 Thermal Conductivity.

1.5 SUBMITTALS

A. Product Data: Submit product data including manufacturer's technical data indicating product performance characteristics, performance and limitation criteria.

B. Manufacturer's Instructions: Submit manufacturer's written installation instructions.

C. Applicator Qualifications: Submit applicator's current certification as a manufacturer trained applicator.

D. Performance Documentation: Submit published design listings for insulation value ratings and product thickness. Include evidence that the liquid thermal break testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of technical personnel.

1.6 QUALITY ASSURANCE

A. Manufacturer

1. Company specializing in manufacturing product in this section with a minimum of 2 years' documented experience in manufacturing insulating technology.

2. Applicator: Company specializing in applying the work of this section with documented experience and certified and trained by the manufacturer.

3. Liquid applied thermal break acrylic system shall be the complete system from a sole source consisting of primer, acrylic thermal break material and topcoat.

B. Mock-Up: Minimum thirty days prior to application in any area, provide mock-up samples of thermal break materials in accordance with the following requirements:

1. Provide minimum two square feet on representative substrate, where directed by the Engineer, for each different desired R Values and finish of required for the work.

2. Provide mock-up areas that comply with thickness, density application, finish texture, and color.

3. Inspect mock-up areas within one hour of application for variance due to shrinkage, temperature, and humidity.

4. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary to meet required installation, R Value, finish, and color requirements.

5. Continue to provide mock-up areas until acceptable areas are produced.

6. Acceptable areas shall constitute standard of acceptance for method of application, thickness, finish texture, and color requirements, for Liquid applied thermal break material applications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, sealed, undamaged container with identification label intact. Packaged materials shall bear the appropriate labels and seals.

B. Materials shall be stored in strict accordance with manufacturer's documented instructions.

1.8 PROJECT CONDITIONS

A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturer's requirements, including the following:

1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of material.

2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.

B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before, during, and after application as recommended by manufacturer.

1. Do not apply coatings when temperature of substrate and/or surrounding ambient air temperature is below 27 degrees C. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during, and 24 hours after material application.

2. Steel substrate temperature shall be a minimum of 3 degrees C above the dew point of the surrounding air for a period of 24 hours prior and during the application of the material.

3. If necessary for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

4. The relative humidity of the application area shall not exceed a maximum of 85 percent 24 hours prior, during and 24 hours after the application of the material. The relative humidity shall not exceed 75 percent throughout the application and drying of the decorative top coat finish.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design: Tnemec Aerolon Series 971 Coating System by Tnemec, Kansas City, MO.

1. Surface Preparation

a. Steel – Shop or Site Applied: Abrasive blast clean, SSPC SP-6 surface profile 2-3 mils. SSPC-SP3 may be used if considered a mild exposed condition (consult Righter Group). Remove weld splatter and grind defects smooth. Steel substrate temperature shall be a minimum of 3 degrees C above the dew point of the surrounding air for a period of 24 hours prior and during the application of the material.
b. Concrete, Site-Applied: Grind all surfaces smooth.
c. Aluminum, Site-Applied: Clean surface of foreign material, grind defects smooth.

2. Primer: Tnemec Series 1224T with less than 11 grams VOC, surface tolerant inorganic epoxy coating, at 6-8 mils DFT or Series 394 in cases where zinc Miox primer is needed.

a. Strength: ASTM D 4541, 1320 psi.
b. Abrasion Resistance: ASTM D 4060, 181 mg.
c. Cathodic Disbondment: ASTM D G8, no disbondment 3000 hours.
d. Water Vapor Transmission: ASTM D 1653, 4.68 g/m^2 /24 hrs. less than 0.22 perms.

3. Aerogel Insulating Coating: Coating Tnemec Series 971, Aerolon liquid-applied thermal break coating.

a. Solids by Volume: 76 percent.
b. Coating Type: Water-based thermal acrylic, spray applied.
c. Recommended Film Thickness: 40-300 mils applied in multiple applications to specified R Value.
d. Fire Performance: ASTM E 84, Class A.
e. VOC Content: 0.01 lbs./Gallon (1.0 grams /liter).
f. Thinned: 0.01 lbs./ gallon (1.0 grams /liter).
g. HAPS: 0 lbs. per gallon solids.
h. Curing Time: 75 degrees F, 4 hours to touch 16 hours to recoat.
i. Thermal Transmission: ASTM C 518, no more than 50 mW/ mK.
j. Required Thermal Resistance: R-value based on project requirements.
1). 40 mils (approx. 1/32 inch): 0.10 R-value.

2). 60 mils (approx. 1/16 inch): 0.25 R-value.
3). 120 mils (approx. 1/8 inch): 0.50 R-value.
4). 250 mils (approx. 1/4 inch): 1.0 R-value.
5). 380 mils (approx. 3/8 inch): 1.5 R-value.
6). 12.5 mm (approx. 1/2 inch): 2.0 R-value.
7). 15 mm (approx. 5/8 inch): 2.5 R-value.
8). 18.5 mm (approx. 3/4 inch): 3.0 R-value.
9). 22 mm (approx. 7/8 inch): 3.5 R-value.

In no case shall the thickness be less than and the required R value required and K value of 35mW/mK per inch. No R value equivalent data is acceptable.

4. Topcoat: Tnemec 1028 Enduratone at 2-3 mils DFT for non-immersion service, Tnemec 22 Series at 15-20 mils DFT depending on application for areas where immersion is required.

   a. Colors: As selected by COR.

2.2 COORDINATION

A. Primer shall be shop applied by Structural Steel Fabricator/Supplier.

B. Field Application of Finish Coats

   1. 60 mils on WF shapes.

   2. 120 mils on tube steel.

C. Extent of use and application shall be indicated on the Contract Drawings, to extend 450mm inboard and 450mm outboard of the exterior face of building exterior wall insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Application shall not commence until the Contractor, Installer and COR have examined the surfaces to receive the primer and determined the surfaces are acceptable to receive the coatings. Commencement of application means acceptance of substrate.

B. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturers recommendations.

3.2 PREPARATION

A. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated.

B. Clean, dry and free of oil, grease, loose mill scale, dirt, dust, or other foreign substances which would impair bond of the material to the substrate.

C. Primer shall not be applied to prepared substrate until the area has been adequately vented to remove all airborne dust. Prior to the application of any coating material, the blast products, dust and debris, shall be removed by vacuuming.

3.3 APPLICATION

A. Equipment and application procedures shall conform to the manufacturer's application instructions. Materials shall be applied at the required dry film thickness per the appropriate R-value specified.

B. Apply primer at thickness recommended by manufacturer. Apply insulating coating at maximum 40-80 mils per wet film thickness (WFT) per lift. Vary color white/yellow on each lift. Subsequent coats shall be applied until final dry film thickness (DFT) is achieved for required R value specified. Final DFT is measured with a dry film thickness gauge. Apply top coat at thickness recommended by the manufacturer.

C. Do not apply coatings to steel deck unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. The Owner will engage an independent testing laboratory inspect and verify the application of material in accordance with the provisions Tnemec Company.

1. Material inspection and testing shall be performed 24 hours after completion of final application coat.

2. The results of the above tests shall be made available to all parties at the completion of each pre-designated area and approval.

3. In-place material not in compliance with desired R Values the specification requirements shall be corrected prior to final acceptance.

B. The dry film thickness (DFT) of the applied material shall be measured with a non-destructive coating thickness gauge after material has completely cured. All measurements shall be documented in writing and furnished to the Owner.

3.5 CLEAN UP AND REPAIR

A. Upon completion of installation, excess material, overspray and debris shall be cleared and removed from the job site. Remove overspray materials from surfaces not required to be thermally protected.

B. Patching and repair to material, due to damage by other trades, shall be performed under this Section and paid for by the trade responsible for the damage. Patching shall be performed by applicators certified by the manufacturer and applied in accordance with the manufacturer's application instructions.

END OF SECTION

SECTION 072616 - BELOW-SLAB VAPOR RETARDER

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the below-slab vapor retarder as shown on the drawings and/or specified herein, including but not limited to the following:

1. Underslab vapor retarder below slab on grade.

2. Confirm that the substrates for the below-slab vapor retarder are acceptable.

3. Integrate the vapor retarder with all surrounding work; coordinate all work with related trades.

4. Provide all necessary permits and fees for this work, including building permits, inspection fees, police detail, etc.

1.3 QUALITY ASSURANCE

A. Work in conjunction with the other trades employed on the project by promptly completing the work of this Section as required to meet the project schedule and so as not to impede other trades. Coordinate the work of this Section with other trades so that the intent of the Drawings and Specifications is carried out. Coordinate with other trades to maximize efficient use of scaffolding, to minimize disruption to the building, and to avoid unnecessary traffic over unprotected roof areas.

B. Conduct a quality control program that includes the following as a minimum:

1. Inspect conditions and materials to ensure conformity to the contract requirements.

2. Continuously inspect substrate conditions and coordinate with the Architect to ensure proper substrate preparation in conformance with the contract requirements.

3. The Contractor shall arrange with the vapor retarder manufacturer to have a competent field representative visit the site to inspect the workmanship and the quality of the work. The manufacturer should visit the site as required to observe the progress of the work, but at least three times during the course of the project. The field representatives shall issue written reports of their findings and recommendations for corrective work, if any, to the Architect. The Contractor shall include all costs for the field representative, including all expenses, in the project bid price.

   a. The representative shall review and approve the condition of substrates prior to application of vapor retarder.
   b. The representative shall observe the first one to two days of application of vapor retarder.

c. Representative shall review and approve below-slab-vapor-retarder conditions prior to pouring concrete.

4. Inspect work in progress and during inclement weather to ensure that the work is in compliance with approved procedures.

5. Inspect all completed and any corrected work for compliance with the Contract Documents and the vapor retarder manufacturers' recommendations.

C. The vapor retarder system shall be applied by an approved contractor authorized by the vapor retarder manufacturer to perform the work.

D. Attend a preconstruction conference to be held with representatives of the Owner, Contractor, Architect, and all other involved trades and parties to discuss the work covered under this Section.

E. Attend weekly job meetings during the course of the work as required by the Owner.

F. The Contractor/Subcontractor and its site superintendent(s) and Foreman shall have at least five years' experience with similar vapor retarder and flashing work with success.

1.4 SUBMITTALS

A. Submit the following items in time to allow for review by the Architect and resubmittals, if needed, without delaying the work. Do not order materials or start work before receiving the Architect's written approval.

1. Shop drawings of all conditions and details, including connection to all surrounding work and isometric (3D) details of complex conditions. Include work sequence for conditions between work of this Section and surrounding work; coordinate with related trades.

2. Contractor's qualifications.

3. Samples and/or manufacturer's literature for all materials specified or proposed for use on the project, properly labeled and referenced to the appropriate specification section. Samples required include, but are not limited to, the following:

a. Vapor retarder, 12" x 12".
b. Seam tape, 6 inches long.
c. Protection layer, 12" x 12".
d. Any product or material proposed for substitution.

4. Certifications (in time for review to prevent delay in the work) by the producers of all materials stating that the materials supplied comply with all the requirements of the referenced standards and that all materials are suitable for the use specified herein.

5. Material Safety Data Sheets (MSDS) for each material where appropriate.

6. Project Schedule and Sequencing. Submit updated project schedule weekly throughout the project to reflect current status and project schedule.

7. Vapor retarder manufacturer's sample warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor is responsible for protecting all materials and equipment stored on the site.

B. All materials to be new. Handle all materials to prevent damage. Place materials on pallets. Use waterproof and fireproof canvas tarpaulins (not polyethylene) to cover all stored materials top to bottom.

C. Deliver materials clearly marked with legible and intact labels with manufacturer's name and brand name and identifying contents of containers.

D. Materials shall be marked with the date of manufacture and shelf life. Do not use products beyond the expiration of their shelf life.

E. Protect all materials in original unopened labeled containers and packaging and in compliance with manufacturer's directions. Comply with manufacturer's recommendations for minimum and maximum time and temperature limits for storage. Store flammable materials in a cool, dry, protected area away from sparks and open flames.

F. Promptly remove from the site all materials rejected by the Architect or exposed to any moisture anywhere, at any time, during transportation, storage, handling, and installation.

G. Do not stockpile materials or equipment to overload any building or site component.

H. Protect materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed when not in use and away from open flames. Protect liquid components from freezing.

I. Store rolled goods on ends only. Discard rolls that have been flattened, creased, or otherwise damaged. Unroll sheets and allow them to "relax" prior to use.

J. Do not dilute primers, waterproofing cements, adhesives, coatings, or sealants. Keep containers closed, except when removing materials. Do not use equipment that is contaminated with materials that may be incompatible with the work.

K. Dispose of debris as required by state and local ordinances. All debris shall be removed from the site and the site returned to its original condition upon completion of the project.

L. Do not allow wrappers, packaging materials, or any other debris to be included in the vapor retarder system.

1.6 PROJECT CONDITIONS

A. Coordinate the work, use of the site, storage areas, and staging areas with the Contractor. Limit use of the site and working hours to dates, times, and locations approved by the Contractor.

B. All equipment used on the project shall comply with all applicable municipal and safety regulations – including OSHA guidelines – and be suitable for reasonable access for inspection of the Owner's representative, who shall have free access to the work via the Contractor's equipment.

C. Compliance with OSHA and all other safety laws and regulations is the exclusive responsibility of the Contractor, its Subcontractors, suppliers, consultants, and servants.

1.7 WARRANTY

A. Warrant all work under this Section in a document stating that if, within two years after the Date of Substantial Completion of the Work, any of the work of this Section is found to be defective or not in accordance with the Contract Documents, the Contractor shall, at its sole cost and expense, correct it promptly after receipt of a written notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. Also, state that the Contractor shall bear all costs incurred by the Owner, including reasonable attorney's fees, court costs, and expert witness and consultant fees, to enforce Contractor's compliance with the obligations of the warranty. The obligations of the warranty shall run directly to the Owner and its successors and assigns and may be enforced by the Owner and its successors and assigns against the Contractor, shall survive the termination of the Contract, and shall not be limited by conditions other than this Contract.

PART 2 PRODUCTS

2.1 GENERAL

A. Check the availability of all specified items early and report any long lead times that may impact the intended schedule to the Owner promptly to prevent delays in the work.

B. All materials are to be new. Handle, store, and install materials as recommended by the manufacturer. Materials shall be delivered to the job site in their original containers with the manufacturer's name, grade, number, and batch identification on the container or packaging.

2.2 MATERIALS

A. Unless approved by the Architect, obtain all vapor retarder materials from the same manufacturer. All components of the vapor retarder system shall be as manufactured by, or approved by, the vapor retarder manufacturer and will be included in the vapor retarder system manufacturer's warranty.

2.3 MATERIALS

A. Unless approved by the Architect, obtain all vapor retarder materials from the same manufacturer. All components of the vapor retarder system shall be as manufactured by, or approved by, the vapor retarder manufacturer.

B. At under-slab conditions, provide moisture barrier cover over prepared base material where indicated in accordance with ASTM E1643. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows:

1. Vapor Retarder: Polyethylene sheet not less than 20 mils thick, which complies with ASTM E1745, Class B. Include manufacturer's recommended adhesive or pressure sensitive tape. Acceptable products include:

   a. Permeance Rating: Less than 0.1 Perms (ASTM F1249) as tested after mandatory conditioning (ASTM E1745, Paras. 7.1.2-5).

2. Approved Manufacturers:

   a. Stego Industries, LLC; Stego Wrap, 15 mil.
   b. Or approved equal.

C. Joint Sealer Tape: Stego Tape by Stego Industries, LLC., by one of manufacturers listed above or approved equal.

D. Mastic: Stego Mastic by Stego Industries, LLC. by one of manufacturers listed above or approved equal.

E. Termination Bar: 14 ga. galvanized steel bar with stiffening ribs along outer edges, 1 in. wide, prepunched bar stock, spacing of holes as indicated in Drawings; Sarnabar by Sarnafil, Inc., by one of manufacturers listed above or approved equal.

1. Fasteners for Termination Bar: 1/4" diameter Tapcons with Stalgard corrosion resistant finish (color blue).

F. Hose Clamp: Stainless steel, worm drive.

PART 3 EXECUTION

3.1 GENERAL WORKMANSHIP

A. Vapor retarder systems shall be installed by contractors specifically authorized by the appropriate manufacturer prior to bid. Perform all work with trained personnel.

B. Arrange work sequence to avoid use of newly constructed vapor retarder for storage, walking surface, and equipment movement. Where access is absolutely required, protect surfaces with smooth 1/2" thick plywood runways to ensure full protection of vapor retarder surfaces and all other work against mechanical damage. Provide additional protection if needed to prevent damage. Move equipment and ground storage areas as work progresses to avoid abuse of completed vapor retarder.

C. Replace any new materials scheduled to remain that are damaged due to weather or other causes during the period of the work at no additional cost to the Owner. If water causes damage, remove and replace all wet materials at no additional cost to the Owner.

D. Do not work in temperatures below 40°F. Comply with applicable recommendations by manufacturers of all materials and workmanship and handling, except as modified in this Section.

E. Promptly remove from the site all damaged, defective, or rejected materials. Remove from the site all materials rejected by the Owner or Architect.

F. Components of the vapor retarder system may be toxic and flammable. Heed all manufacturer’s cautions and warnings concerning their use. Completed vapor retarder is slippery when wet or frost covered. Take proper precautions.

G. Do not use equipment for vapor retarder installation that is contaminated with materials that may be incompatible.

H. Workers and all others that walk on the waterproofing membrane shall wear clean soft-soled shoes so as not to damage vapor retarder and related materials.

3.2 REPAIR AND PREPARATION OF SURFACES TO RECEIVE VAPOR RETARDER

A. General

1. Examine all surfaces scheduled to receive vapor retarder for roughness, contaminants, unsound structural substrates, or other conditions that may impair the vapor retarder application. Notify the Architect in writing of any such conditions; do not commence work until all defects are remedied.

2. Clean all substrates of all foreign substances and remove loose materials, grease, oil, and other contaminants. The vapor retarder contractor and manufacturer shall inspect and approve the substrates before application of the vapor retarder system.

B. For horizontal surfaces to receive vapor retarder, the earth and crushed stone substrates shall be compacted to produce an even, sound substrate. Loose aggregate, sharp protrusions, and standing water shall be removed.

3.3 VAPOR RETARDER INSTALLATION

A. General

1. Conform to recommendations and published specifications of the manufacturer, including environmental requirements.

2. Do not allow water to pond on vapor retarder. Promptly remove water that collects on vapor retarder with vacuum or other method acceptable to Architect.

B. Installation of Below-Slab Vapor Retarder

1. Install a continuous layer of protection layer over the substrate immediately before installing the vapor retarder. Overlap sheets of protection layer approximately 4 in. Stagger laps between protection layer and vapor retarder.

2. Vapor Retarder Installation: Below-slab vapor retarder shall be applied horizontally over the substrate. Minimize joints between sheets of vapor retarder to the greatest extent practical, without inhibiting the work. Overlap ends of sheets a minimum of 6 in. Overlap subsequent sheets 6 in. The below-slab vapor retarder sheets shall extend minimum 24 in. (or more if required on Drawings) past the future edge of the slab to allow for effective joining of the below-slab vapor retarder with foundation waterproofing.

3. Cleaning Edges and Seams: All lap/seam areas shall be fully cleaned prior to taping. If contaminated by dust, debris, water, or other contaminants, fully clean the seam with the cleaner recommended by the manufacturer and allow the seam area to fully dry before completing the seam.

4. Sealing Seams and Edges: Install seam tape within all seams. Provide a continuous unbroken seal. Roll seams with a rubber roller with moderate pressure; achieve continuous adhesion.

5. Sealing Penetrations: Penetrations shall be flashed with prefabricated pipe boots to the greatest extent practicable. Other penetrations shall be fully wrapped with vapor retarder material. Seal all seams and edges with seam tape. Provide stainless steel hose clamps at round penetrations.

6. T-Joints: Take extra care at T-joints to ensure that pinhole tunnels are not created. Install an additional patch of seam tape if needed.

7. Inside Corner Forming: Vapor retarder at inside corners shall be folded and creased (not cut) to the greatest extent practicable. The folded flap shall be taped in place with seam tape.

8. Joining and Sealing Below-Slab Vapor Retarder with Foundation Wall Waterproofing: Follow Drawings and manufacturer's installation instructions and ensure that all joints are fully and continuously sealed.

    a. After concrete is poured, secure and seal top of below-slab vapor retarder to foundation with two rows of seam tape and termination bar (fastened 8 in. o.c.) installed 2 in. below the top edge; seal the top edge. Foundation wall waterproofing shall shingle over vapor retarder a minimum of 12 in.; seal edge.

3.4 VAPOR RETARDER INSPECTION AND REPAIR

A. Inspection and repair of the below-slab vapor retarder system shall occur before installation of the reinforcement steel, before installation of formwork, and prior to placement of the concrete. Punctures shall be repaired as follows:

1. Clean surface with damp cloth, or water jet if required. Allow to dry.

2. For pinholes, apply repair tape, centered over puncture, roll firmly, remembering to remove release liner.

3. For damage other than pinholes, apply vapor retarder patch that extends 6 in. beyond opening; seal edges with seam tape.

4. Remove and reinstall concrete reinforcement if required for installation of patch.

3.5 CLEAN-UP

A. Upon completion of the vapor retarder system, the General Contactor shall remove all equipment, material, and debris from the work and storage area, and leave those areas in an undamaged and acceptable condition.

B. All water shall be removed from the vapor retarder before placement of concrete.

END OF SECTION

SECTION 072700 - VAPOR-PERMEABLE AIR BARRIER LIQUID MEMBRANE

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the vapor permeable air barrier liquid membrane as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Vapor permeable/air barrier applied over sheathing board and cold-formed metal framing and over concrete unit masonry and concrete.

2. Materials and installation to bridge and seal the following air leakage pathways and gaps:

a. Connections of the walls to the roof.
b. Connections of the walls to the foundations.
c. Seismic and expansion joints.
d. Openings and penetrations of window frames, storefront, curtain wall.
e. Door frames.
f. Piping, conduit, duct, and similar penetrations.
g. Masonry ties, screws, bolts, and similar penetrations.
h. All other air leakage pathways in the building envelope.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Cold-Formed Metal Framing, including gypsum sheathing - Section 054000.

1.4 SUBMITTALS

A. Provide evidence to the Architect of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program

B. Submit shop drawings showing locations and extent of air barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.

C. Submit manufacturer's product data sheets for each type of membrane, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

D. Submit manufacturer's data showing solids content of fluid applied membranes and coverage rates and wet film thickness upon application in order to achieve minimum dry film thickness required by this specification.

E. Submit manufacturer's installation instructions.

F. Submit certification by air barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

G. Submit certification of compatibility by air barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it, including sealant as specified in Section 054000 for caulking joints between sheathing panels.

H. Submit samples, 3 by 4 inch minimum size, of each air barrier material required for Project.

I. Test results of air permeability testing of primary air barrier material (ASTM E 2178-01).

J. Test results of assembly in accordance with ASTM E 2357.

K. Proof that the air barrier is part of an NFPA 285 approved wall assembly.

1.5 PERFORMANCE REQUIREMENTS

A. Provide air barrier constructed to perform as a continuous air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

B. Provide an air barrier assembly that has been tested in accordance with the Air Barrier Association of America's (ABAA's) approved testing protocol to provide air leakage results not to exceed 0.01 cfm/sf @ 1.57 psf as per ASTM E2357.

C. NFPA 285 Compliance

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.

2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA.

3. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air barrier work on the project.

B. Single-Source Responsibility: Obtain air barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

D. Field-Constructed Mock-Ups: Prior to installation of air barrier, apply air barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution:

1. Construct typical exterior wall panel, 8 feet long by 8 feet wide, incorporating back-up wall, cladding, window and door frame and sill, insulation, flashing, building corner condition, and typical penetrations and gaps; illustrating materials interface and seals.

E. Test mock-up in accordance with ASTM E783 and ASTM E1105 for air and water infiltration.

F. Manufacturer shall be on-site at least once a week to observe installation and provide written report within 3 days.

G. Manufacturer shall confirm all termination details and compatibility with materials being terminated to.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer. Protect stored materials from direct sunlight.

C. Avoid spillage. Immediately notify Owner, Architect if spillage occurs and start clean-up procedures.

D. Clean spills and leave area as it was prior to spill.

1.8 WARRANTY

A. System Warranty: Provide the manufacturer’s five (5) year material warranty, including the primary air barrier and installed accessory sealant and membrane materials.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fluid-Applied Membrane: Henry "Air-Bloc 17MR Vapor Permeable Fluid-Applied Membrane," GCP Applied Technologies' "Perm-A-Barrier VP," or approved equal. Trade names used herein are those of the Henry Company.

B. Transition Membrane: Blueskin SA or Blueskin VP 160.

C. Window and Door Opening Flashing: Metal Clad.

D. Liquid Applied Flashing: Henry Air-Bloc LF.

E. Through-Wall Flashing: Blueskin TWF.

F. Primer: Blueskin LVC Adhesive.

G. Sealant: Henry HE 925 BES Sealant.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where vapor permeable air barrier liquid membrane is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the work.

3.2 SURFACE PREPARATION

A. All surfaces must be sound, dry, clean, and free of oil, grease, dirt, excess mortar, or other contaminants.

B. Cracks in concrete up to 1/2" wide shall be filled with a trowel application of Liquid Applied Flashing or Sealant and allowed to skin over prior to application of the fluid-applied membrane to the surface. Alternatively, the cracks may be sealed with a strip of Transition Membrane applied to the substrate.

C. Joints in sheathing up to 1/2" shall be treated with Liquid Applied Flashing or Sealant.

D. Surfaces shall be tied-in with beams, columns, etc. using strips of Transition Membrane lapped a minimum of 3" on both substrates. Mechanical attachment should be made to all window and door frames, or a properly designed sealant joint provided.

3.3 TRANSITION MEMBRANE

A. Align and position self-adhering transition membrane, remove protective film and roll firmly into place with heavy roller. Ensure minimum 2" overlap at all ends and side laps.

B. Tie-in to window frames, metal door frames, etc., and at the interface of dissimilar materials as indicated on the Drawings.

C. Promptly roll all laps and membrane with a countertop roller to effect seal.

D. Ensure all preparatory work is complete prior to applying Liquid Applied Membrane

3.4 THROUGH-WALL FLASHING MEMBRANE

A. Ensure all preparatory work is complete prior to applying Thru-Wall Flashing.

B. Align and position the leading edge of Thru-Wall Flashing with the front horizontal edge of the foundation walls or shelf angles, partially remove protective film and roll membrane over surface and up vertically.

C. Roll firmly into place. Ensure minimum 2" overlap at all end and side laps.

D. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.

E. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors, and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 4-1/2" up the back-up wall.

F. When flashing at window openings, wrap the entire window opening with air barrier flashing membrane.

3.5 FLUID-APPLIED MEMBRANE APPLICATION

A. Apply fluid-applied membrane to wall substrates in a continuous coat at manufacturer's recommended rate by spray or trowel to provide a minimum wet film thickness of 0.090" (90 mils) for rough surfaces like concrete and 0.070" (70 mils) for smooth sheathing.

1. Minimum dry film thickness shall be 0.037" (37 mils) on smooth sheathing.

B. Overlap liquid membrane on to transition membrane at connections a minimum of 1".

C. Do not leave membrane exposed for any longer than 180 days.

D. Penetrations: Seal all penetrations with Liquid Applied Flashing or Sealant or other procedures in accordance with manufacturer's instructions.

3.6 PROTECTING AND CLEANING

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Protect air barrier from exposure to the elements as required by the manufacturer.

D. Remove any masking materials after installation. Clean any stains on materials that would be exposed in the completed work using procedures as recommended by manufacturer.

1. Schedule work to ensure that the air and vapor barrier system is covered as soon as possible after installation. Protect air and vapor barrier system from damage during subsequent operations. If the air and vapor barrier system cannot be permanently covered within 180 days after installation, apply temporary UV protection.

3.7 FIELD QUALITY CONTROL

A. Air Barrier Association of America Installer Audits: Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site inspections by ABAA to verify conformance with the material Manufacturer's instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

1. Audits and subsequent testing shall be carried out at the following rate:

a. Up to 10,000 ft^2 of air barrier contract requires one (1) audit.
b. 10,001 – 35,000 ft^2 of air barrier contract requires two (2) audits.
c. 35,001 – 75,000 ft^2 of air barrier contract requires three (3) audits.

d. 75,001 - 125,000 ft^2 of air barrier contract requires four (4) audits.
e. 125,001 – 200,000 ft^2 of air barrier contract requires five (5) audits.
f. 200,001 ft^2 and over of air barrier contract requires six (6) audits.

2. Forward written audit reports to the Architect within 10 working days of the inspection and test being performed.

3. If the inspections reveal any defects, promptly remove and replace defective work at no additional cost to the Owner.

B. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

2. Remove and replace deficient air-barrier components for retesting as specified above.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

END OF SECTION

SECTION 073113 ASPHALT SHINGLES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the asphalt shingles as shown on the Drawings and specified herein, including, but not limited to, the following:

1. Fiberglass-asphalt roof shingles.
2. Underlayments.
3. Metal flashing.
4. Ridge vent.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide products that are identical to those tested for the specified fire performance characteristics by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspection organization.

1. Fire Resistance Ratings: As indicated by reference to design designations in UL "Fire Resistance Directory."

B. Assembly shall be installed in accordance with ASCE 7 and State of New York Building Code standards, whichever is more stringent.

1.5 PRE-ROOFING CONFERENCE

A. Prior to ordering of materials, a pre-roofing conference will be held to discuss the specified roofing system, and its proper application. Conference shall include installer, roofing manufacturer, installers of related work, Architect, and representatives of the Owner. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours' advance notice to participants prior to convening conference.

B. Coordinate application of the roofing system in such a manner that the complete installation is weather-tight and in accordance with guarantee requirements.

1.6 SUBMITTALS

A. Product data for each type of product specified, including details of construction relative to materials, dimensions of individual components, profiles, textures, and colors.

B. Samples for initial selection purposes in form of manufacturer's sample finishes showing full range of colors and profiles available.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in manufacturer's unopened bundles or containers with labels intact.

B. Handle and store materials at site to prevent water damage, staining, or other physical damage. Store roll goods on end. Comply with manufacturer's recommendations for job site storage, handling and protection.

1.8 PROJECT CONDITIONS

A. Weather Conditions: Proceed with work only when existing and forecasted weather conditions will permit work to be installed in compliance with manufacturer's recommendations and when substrate is completely dry.

1.9 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace asphalt shingles that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, deformation or deterioration of shingles beyond normal weathering. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

1. Warranty period shall be 40 years with the first 20 years non-prorated, starting after project acceptance by Owner.

2. Include all elements of roof (i.e. nail base, insulation, etc.) in 30-year warranty.

PART 2 PRODUCTS

A. Shingles, UL Class "A" Heavy Weight: Match existing.

B. Hip and Ridge Shingles: Manufacturer's standard factory precut units to match shingles.

C. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for asphalt shingles of type specified.

2.2 ACCESSORIES

A. Asphalt Plastic Cement: Non-asbestos fibrated asphalt cement complying with ASTM D 4586, designed for trowel application.

B. Shingling Nails: Stainless steel, type 316, 10 or 12 gauge, sharp-pointed, conventional roofing nails with barbed shanks, minimum 3/8" diameter head, and of sufficient length to penetrate 3/4" into solid decking or to penetrate through plywood sheathing. Material of nails in contact

with flashing shall match materials selected for flashing to prevent galvanic action. All fasteners shall be designed for Hurricane Code.

C. Metal Drip Edge: Minimum 16 oz. copper sheet, brake-formed to provide 3" roof deck flange and 1-1/2" fascia flange with 3/8" drip at lower edge. Furnish in lengths of 8 or 10 feet.

D. Metal Flashing: As specified in Section 076200.

E. Open Valley Metal Flashing: Preformed, inverted "V" profile at center of valley and extending at least 9" in each direction from center line of valley. Flashing shall be 16 oz. lead coated copper.

F. Waterproof Underlayment (over entire roof): Minimum 40 mil thick, self-adhering, polymer modified bituminous sheet membrane, complying with ASTM D 1970. Provide primer when recommended by underlayment manufacturer. Provide "Vycor Ice and Water Shield" made by W. R. Grace, GAF "StormGuard" or approved equal.

G. Ridge Vent: Provide unit fabricated with internal baffles, configured to roof slope, self-flashed with matching end closures, providing minimum of 12 square inches minimum of free air per linear foot; one of the following, or approved equal:

1. "Vent-A-Ridge," Alcoa Building Products.
2. "PRV-4," by Ampcor, The Solar Group.
3. "RidgeMaster Plus," Mid-America Building Products Corp.
4. "Shingle Vent II," Air Vent, Inc.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where asphalt shingles are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application. Cover knot holes or other minor voids in substrate with sheet metal flashing secured with non-corrosive roofing nails.

B. Coordinate installation with flashings and other adjoining work to ensure proper sequencing. Do not install roofing materials until all vent stacks and other penetrations through roofing have been installed and are securely fastened against movement.

3.3 INSTALLATION

A. Comply with manufacturer's installation instructions and recommendations, but not less than recommended by "The NRCA Steep Roofing Manual."

B. Waterproof Underlayment: Apply waterproof underlayment over entire roof area.

C. Metal Open Valleys: Comply with ARMA, NRCA, and SMACNA recommendations.

D. Install asphalt shingles beginning at lower end with a starter strip of roll roofing or inverted shingles with tabs removed. Fasten shingles in pattern, with weather exposure, and using number of fasteners per shingle as recommended by manufacturer. Use vertical and horizontal chalk lines or premarked underlayment to ensure straight coursing.

1. Cut and fit asphalt shingles at ridges and edges to provide maximum weather protection. Provide same weather exposure at ridges as specified for roof. Lap shingles at ridges to shed water away from direction of prevailing wind. Fasteners at ridges shall be of sufficient length to penetrate sheathing as specified.

2. Set shingle pattern as recommended by shingle manufacturer for shingle selected.

E. Flashing: Install metal flashing in accordance with details and recommendations of the "Asphalt Roofing" section of "The NRCA Steep Roofing Manual."

F. Ridge Vents: Install ridge vents according to manufacturer’s instructions.

3.4 ADJUSTING

A. Replace any damaged materials installed under this Section with new materials meeting specified requirements.

1.2 END OF SECTION

SECTION 074213.19 - INSULATED METAL WALL PANELS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the insulated metal wall panels as indicated on the drawings and/or specified herein, including the following:

1. Foamed-insulation-core metal panels.

2. Sub-girts, trim, feature strips and accessories required for complete installation.

3. Sealant in conjunction with metal panel work.

1.3 RELATED SECTIONS

A. Cold-Formed Metal Framing - Section 054000.

B. Joint Sealants - Section 079200.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

B. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.5 PERFORMANCE CRITERIA

A. Structural Design: Design calculations, certified by a registered professional engineer licensed in the State of New York, shall be submitted to verify load carrying capability of panel system. Panel system shall be capable of resisting a minimum positive and negative wind load per ASCE-7 or New York State Building Code, whichever is more stringent, with a deflection of L/180.

B. Air Infiltration: The panel system shall be tested for static air infiltration in accordance with ASTM E283. The maximum allowable leakage shall be 0.06 CFM/sq. ft. at a static pressure of 12.0 psf.

C. Water Penetration: No uncontrolled water shall occur when the panel system is subjected to a static water infiltration test per ASTM E331 at a positive pressure differential of 6.24 or 20% of the design wind pressure, whichever is greater.

1.6 SUBMITTALS

A. Manufacturer's Data: Submit standard detail drawings and installation instructions for insulated metal wall panels. Include manufacturer's certification or other data substantiating that the materials and finishes comply with the requirements. Indicate by copy of transmittal that the Installer has received a copy of the installation instructions.

B. Samples: Submit twelve (12) inch long by full width samples of insulated metal wall panels, complete with factory applied finish. Samples will be reviewed by Architect for pattern, texture and color only. Compliance with other requirements is the exclusive responsibility of the Contractor.

C. Shop Drawings: Submit shop drawings showing the profiles of insulated metal wall panels, and the details of forming, jointing (gaskets, if any), internal supports, anchorages, trim, flashing, and accessories. Show details of weatherproofing at edges, terminations, and penetrations of the metal panel work. Show small scale layout and elevations of entire work.

D. Engineering Data: Submit engineering and test data and tables showing performance characteristics of the panels for loads, deflections and infiltration of air and water meeting standards specified herein.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 COORDINATION

A. Contractor must carefully coordinate his work with work of other trades that are penetrating through or connecting to the insulated metal wall panels. Openings required in panels to accommodate penetrations must be neatly and accurately made in the shop prior to job site delivery.

B. Provide concealed reinforcing plates, anchors and supports to receive items mounted on panels as required to prevent deflection of panels.

C. Provide all necessary trim, flashing, sealant as specified herein to ensure watertight integrity of panels where penetrations occur.

1.9 WARRANTY

A. Exterior panel finish shall be warranted for a period of ten (10) years against failures of any kind.

B. Wall system shall be warranted for a period of five (5) years against failures of any kind.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Provide "Designwall 2000," Flat Panel, metal wall panel system, as manufactured by Morin, a Kingspan Group Company, or comparable product by Centria, Metl-Span, or approved equal.

2.2 MATERIALS

A. Substrate and Core: ASTM A 653, Grade 37, 22 gauge steel with zinc coating conforming to designation G90, with polyisocyanurate foam-insulated core.

B. Joinery: Exterior face designed for horizontal applications shall have rainscreen, pressure-equalized and drainable joinery, 1/2" nominal joint.

1. Double tongue-and-groove, shiplap side joint design with fasteners concealed within side joint.

2. Interior female joints factory caulked.

3. Where so indicated on drawings, trimless or closed end panels shall be factory fabricated and utilize a field installed recessed, dry gasket in lieu of exposed wet sealant or battens.

4. Provide custom shaped panels, trim and sections as detailed and as required by field conditions.

C. Surface Finish: Non-directional, embossed flat.

D. Finish Coating System

1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

a. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 621.
b. Color shall be custom color and gloss as selected by the Architect. Color samples shall be submitted and approved prior to application of color coating.

E. Panel Thickness: 2" thick.

F. Panel Module: Custom size as indicated.

G. Thermal Resistance (R-Value): R-22 based on ASTM C 1363.

H. Factory Insulation: Poured-in-place urethane modified polyisocyanurate foam core with the following minimum physical characteristics:

1. Density: 2.7 lbs./cu. ft.

2. Compressive Strength: 20 psi.

3. Tensile Strength: 30 psi.

I. Periphery Trim: Concealed fasteners shall be used.

1. Extruded galvanized steel sections shall be supplied with a finish to match panels, unless noted otherwise. All joints in extrusions shall have internal lap strips faced on outside with bond breaker tape and face sealed with silicone sealant. Extrusions shall be designed with wiper gaskets to eliminate field applied sealants wherever indicated on drawings.

2. Sheet metal trim shall be embossed material with exterior finish to match panels. Gauges shall be adequate to insure flatness of flat face exposed in all instances.

3. The use of exposed silicone wet sealants is prohibited.

J. Sub-Girts: Metal sub-girts shall be formed from 16 gauge hot dip galvanized steel so that they will provide the necessary combined action between the face sheet and liner to meet design criteria. Sub girts shall be of the adjustable type.

2.3 FABRICATION

A. Comply with dimensions, profile limitations, gauges, and fabrication details shown on contract drawings; and if not shown, provide manufacturer's standard product fabrication and details.

B. Fabricate components of the system at factory, ready for field installation.

C. Fabricate components and assemble units to comply with fire and/or performance requirements specified.

D. Apply specified finishes in conformance with manufacturer's standards and according to coating manufacturer's instructions.

E. Changes of plane, parallel or transverse to longitudinal axis shall be accomplished as detailed on the drawings in the factory wherever practical and with a minimum of field fabrication.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where insulated metal wall panels are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Comply with panel manufacturer's instructions for assembly, installation, and erection of insulated metal wall panels.

B. Metal Separation: Apply a coat of bituminous paint, concealed, on one or both surfaces wherever dissimilar metals would otherwise be in contact. Use gasket fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

C. Anchor sub-girts to stud back-up spacing sub-girts not to exceed 16" o.c. unless closer spacing required to meet deflection criteria. Use stainless steel anchors to fasten sub-girts to stud framing; space anchors 8" o.c. at each stud.

D. Erect panels plumb, level, and true to line with tolerances not exceeding 1/16" in runs of 20' and within 1/16" of adjoining faces.

E. Fasteners: Provide a concealed fastener installation system, with no fasteners exposed on face of work.

F. Joint Sealers: Install gaskets, joint fillers and sealants where required for weatherproof performance of panel systems. Provide types of gaskets and sealants/fillers recommended by panel manufacturer.

G. Damaged Material: Remove and replace panels and component parts of the work which have been damaged (including finish) beyond successful repair, as directed by the Architect. Repair minor damage.

3.3 CLEANING AND PROTECTION

A. Clean exposed surfaces (exterior and interior) of insulated metal wall panels promptly after completion of installation. Comply with recommendations of both the panel and coating manufacturer.

B. Protection: The Installer of insulated metal wall panels shall advise the Contractor in writing of protection and surveillance procedures which can be foreseen as needed to ensure that the work will be without damage or deterioration at the time of final acceptance after completion of other construction work.

END OF SECTION

SECTION 075560 COLD FLUID APPLIED MEMBRANE ROOFING

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 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the cold fluid applied reinforced polyurethane roofing and waterproofing membrane, for both exposed membrane conditions and pavers and pedestals and all other ancillary waterproofing work including but not limited to installation of drains, pipe flashings, penetration flashings, sealants and metal work as specified, and including but not limited to, the following:

1. Adhered cold fluid-applied reinforced PMMA waterproofing system including, membrane, penetration flashings, base flashings, and expansion joints.

    a. Conventional installation.

2. Substrate preparation, cleaning, leveling and patching

3. Temporary waterproofing and priming

4. Waterproofing membrane installation

5. Flashing installation and expansion joint installation

6. Protective surfacing

7. Alkalinity protection

8. Insulation installation

1.3 RELATED SECTIONS

A. Concrete deck - Section 033000.

B. Carpentry - Section 062000.

C. Sheet metal work - Section 076200.

D. Roof accessories - Section 077100.

E. Roof drains, plumbing vents, roof mounted mechanical equipment - Division 22.

1.4 REFERENCES

A. National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual.

B. ACI-308 - Recommended Practice for Curing Concrete

C. ASTM D 638 - Test Methods for Tensile Properties of Plastics

D. ASTM D 4258 - Standard Practice for Surface Cleaning Concrete for Coatings

E. ASTM D 4259 - Standard Practice for Abrading Concrete

F. ASTM D 4541 - Method for Pull-Off Strength of Coatings using Portable Adhesion Tester

G. ASTM E 96(A) - Test Methods of Moisture Transmission of Material

H. ASTM E 108, ANSI/UL 790 for Fire Resistance

I. International Concrete Repair Institute Guideline 03732 Concrete Surface Preparation

J. Steel Structures Painting Council (SSPC)

1.5 SUBMITTALS FOR REVIEW

A. Membrane System Product Data: Provide current standard printed product literature indicating characteristics of membrane materials, flashing materials, components, and accessories product specification and installation.

B. Vegetated System Product Data: Provide current standard printed product literature for vegetated system components, growing media type, and planting types indicating characteristics and limitations.

C. Product Samples: Submit product samples of green roof media, perimeter gravel, membrane and flashing materials showing color, texture, thickness and surfacing representative of the proposed system for review and approval by the Owners Representative and Architect.

D. Submit sample copies of both the Manufacturer and Applicator warranties for the periods stipulated. Each specimen must be a preprinted representative sample of the issuing company's standard warranty for the system specified.

E. Submit copies of current Material Safety Data Sheets (MSDS) for all components of the work.

F. Membrane Shop Drawings: Submit shop drawings of cold fluid-applied reinforced polyurethane showing all a project plan, size, flashing details, and attachment for review and approval by the Owners Representative and Membrane Manufacturer.

G. Submit a letter signed by the manufacturer and Contractor acknowledging that the submitted roofing system complies with ASCE-7, for wind speed requirements based on height of structure and geographic location of project.

1.6 QUALITY ASSURANCE

A. Membrane Supplier: Company specializing in manufacturing the products specified in this section with ten (10) years documented experience. Membrane Manufacturer shall submit the following certifications for review:

1. Substrates and conditions are acceptable for purpose of providing specified warranty.

2. Materials supplied shall meet the specified requirements.

B. Applicator: Company specializing in performing the work of this section with (3) years documented experience and approved by system manufacturer/supplier for warranted membrane and vegetated system installation. Applicator shall submit the following certification for review:

1. Applicator shall submit documentation from the membrane manufacturer/vegetated system supplier to verify contractor's status as an approved applicator for warranted installations.

C. Evaluate moisture content of substrate materials. Constructor shall determine substrate moisture content throughout the work and record with Daily Inspection Reports or other form of reporting acceptable to the Owner or designated Representative, and Membrane Manufacturer.

D. Random tests to determine tensile bond strength of membrane to substrate shall be conducted by the Contractor at the job site using an Elcometer Adhesion Tester Model 106 or similar device, or by the performance of a manual pull test. Contractor shall perform tests at the beginning of the Work, and at intervals as required to assure specified adhesion with a minimum of three (3) tests per 5000 square feet. Smaller areas shall receive a minimum of three (3) tests. Test results shall be submitted to the Owner or his designated Representative and the Membrane Manufacturer. Contractor shall immediately notify the Owner or his designated Representative and Membrane Manufacturer in the event bond test results are below specified values.

1. Adequate surface preparation will be indicated by tensile bond strength of membrane to substrate greater than or equal to 220 psi (1.5 N/mm^2), as determined by use of an adhesion tester.

2. Adequate surface preparation will be indicated by 135° peel bond strength of membrane to substrate such that cohesive failure of substrate occurs before adhesive failure of membrane/substrate interface.

3. In the event the bond strengths are less than the minimum specified, additional substrate preparation is required. Repeat testing to verify suitability of substrate preparation.

E. Monitor quantities of installed materials. Monitor application of resin mixture, reinforcing fleece and flashing. Perform Work in accordance with manufacturer's instructions.

F. Mock-up areas shall be used to determine required methods and tools to obtain degree of substrate preparation required by the membrane manufacturer. Conduct tests as required to verify that substrate preparation meets specified requirements. Tests shall include, but are not limited to, tensile bond strength and moisture content of substrate. In addition, mock-up areas shall be used to confirm application practices in the installation of the membrane and vegetative system assembly.

1. Prepare and clean a three (3) foot (0.9 m) by three (3) foot (0.9 m) area of each substrate material type.

2. Submit findings in writing to Owner or his designated Representative and Membrane Manufacturer.

3. Mock-up areas shall be maintained for quality control for the entire project.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable building and jurisdictional codes for roofing/waterproofing assembly and fire resistance requirements.

B. Comply with requirements of OSHA, NIOSH or local governing authority for work place safety.

C. Comply with authority or agency "Confined Space Policy" during and throughout all work to be performed.

1.8 PRE-INSTALLATION MEETING

A. Convene a pre-installation meeting at the job site (1) week before starting work of this section. Require attendance of parties directly affecting work of this section, including but not limited to, Architect and Owner's Representative, Roofing/Waterproofing/Landscaping Contractor, and Membrane Manufacturer/Vegetative System Representative. Review roofing/waterproofing/vegetative system (all of these to be reviewed) preparation and installation procedures, coordination and scheduling required with related work, and condition and structural loading limitations of deck/substrate.

1.9 FIELD INSPECTION SERVICES

A. Manufacturer's technical representative shall provide the following inspections of the membrane application:

1. Jobstart inspection at the beginning of each phase of the project, to review special detailing conditions and substrate preparation.

2. Periodic in-progress inspections throughout duration of the project to evaluate membrane and flashing application.

3. Final punch-list inspection at the completion of each phase of the project prior to installation of any surfacing or overburden materials.

4. Warranty inspection to confirm completion of all punch list items, followed by 24 hr. flood test to confirm watertightness of installed waterproofing membrane.

5. In-progress inspection during vegetative system installation to confirm tray, perimeter metal securement, and irrigation system installation prior to growing media installation.

6. Final inspection to confirm completion of planting installation.

1.10 DELIVERY, STORAGE, AND PROTECTION

A. The Contractor together with the Owner or his designated Representative shall define a storage area for all components. The area shall be cool, dry, out of direct sunlight, and in accordance with manufacturer's recommendations and relevant regulatory agencies. Materials shall not be stored in quantities that will exceed design loads, damage substrate materials, hinder installation or drainage.

B. Store solvent-bearing solutions, resins, additives, inhibitors or adhesives in accordance with the MSDS and/or local fire authority. After partial use of materials replace lids promptly and tightly to prevent contamination.

C. Rolls of fleece reinforcing materials shall be stored horizontally on platforms sufficiently elevated to prevent contact with water and other contaminants. DO NOT use rolls that are wet, dirty or have damaged ends. Fleece reinforcing materials must be clean, dry, and free of all contaminants.

D. Roofing/waterproofing materials must be kept dry at all times. If stored outside, raise materials above ground or roof level on pallets and cover with a tarpaulin or other waterproof material. Plastic wrapping installed at the factory should **not** be used as outside storage covers.

E. Follow manufacturer's directions for protection of vegetated system materials prior to and during installation. Do not use materials that have been damaged to the point that they will not perform as specified.

F. Store preplanted trays, hardscape materials, growing media, and palletized materials over plywood panels or protective sheeting laid over the finished waterproofing membrane to prevent damage to the membrane.

G. Maintain health of plants as recommended by nursery guidelines prior to rooftop installation. Provide water source for irrigation of and maintenance of plants until permanent drip or alternative irrigation system is in place.

H. Copies of all current MSDS for all components shall be kept on site. Provide any and all crew members with appropriate safety data information and training as it relates to the specific chemical compound he or she may be expected to deal with. Each crew member shall be fully aware of first-aid measures to be undertaken in case of incidents. Comply with requirements of OSHA, NIOSH or local governing authority for work place safety.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing/waterproofing membrane during or with the threat of inclement weather.

B. Application of cold fluid-applied reinforced polyurethane roofing/waterproofing membrane may proceed while air temperature is between 40°F (5°C) and 85°F (30°C) providing the substrate is a minimum of 5°F above the dew point.

C. When ambient temperatures are at or expected to fall below 50°F (10°C), or reach 85°F (30°C) or higher, follow Membrane System Manufacturer's recommendations for weather related additives and application procedures.

D. Ensure that substrate materials are dry and free of contaminants. DO NOT commence with the application unless substrate conditions are suitable. Contractor shall demonstrate that substrate conditions are suitable for the application of the materials.

E. Odor control and elimination measures are not typically necessary, but if required by the Owner or his designated Representative, Contractor shall implement odor control and elimination measures prior to and during the application of the roofing/waterproofing materials. Control/elimination measures shall be field tested at off-hours and typically consists of one (1) or a multiple of the following measures:

1. Sealing of air intakes with activated carbon filters. Install filters in accordance with requirements and recommendations of the filter manufacturer. Seal filters at joints and against building exterior walls to prevent leakage of unfiltered air where required due to size of intake opening. Provide track system to secure filters.

2. Erection and use of moveable enclosure(s) sized to accommodate work area(s) and stationary enclosure for resin mixing station. Enclosure shall be field constructed or pre-manufactured of fire retardant materials in compliance with local code requirements in accordance with requirements of the Owner or his designated Representative. Equipment enclosure(s) with mechanical air intake/exhaust openings and Odor Control Air Cleaners, as required to clean enclosed air volume and to prevent odor migration outside the enclosure. Exhaust opening shall be sealed with activated carbon filter.

3. Placement of odor elimination stations inside and outside of the enclosure(s) as required by field condition, in coordination with the Owner or his designated Representative.

4. Protection of Contractor personnel and occupants of the structure and surrounding buildings as necessary to comply with requirements of OSHA, NIOSH and/or governing local authority.

F. Install plant materials at temperatures between 40 degrees F and 95 degrees F. Do not install plants in freezing conditions or when overnight frost is expected.

G. When disposing of all refuse or unused materials, observe all EPA, OSHA or local disposal requirements.

1.12 COORDINATION AND PROTECTION

A. Coordinate the work with the installation of associated metal flashings, accessories, appurtenances, etc. as the work of this section proceeds.

B. Building components shall be protected adequately (with tarp or other suitable material) from soil, stains, or spills at all hoisting points and areas of application. Contractor shall be responsible for preventing damage from any operation under its Contract. Any such damage shall be repaired at Contractor's expense to Owner's satisfaction or be restored to original condition.

C. Provide barricades, retaining ropes, safety elements (active/passive) and any appropriate signage required by OSHA, NIOSH, and NSC and/or the Owner or designated Representative.

D. Protect finished roofing/waterproofing membrane from damage by other trades. Do not allow waste products containing petroleum, grease, acid, solvents, vegetable or mineral oil, animal oil, animal fat, etc. or direct steam venting to come into direct contact with the membrane.

1.13 WARRANTY

A. Manufacturer's Premier Warranty: Provide (20) year manufacturer's premier warranty under provisions of this section. This warranty provides for cost of labor and materials for loss of watertightness, limited to amounts necessary to effect repairs necessitated by either defective material or defects in related installation workmanship, with no dollar limitation ("NDL"). Warranty to include basic removal and replacement of vegetated overburden and pavers as required for performance of warranty repairs to the waterproofing membrane.

B. Waterproofing Contractor's Warranty: Provide (5) year "Applicator Maintenance Warranty" covering workmanship for all work of this section including installation of membrane, flashings, metal work, and roofing/waterproofing accessories.

C. Submit (2) executed copies of both the manufacturer and applicator warranties for the periods stipulated, starting from the date of substantial completion. Each warranty must be signed by an authorized representative of the issuing company.

1.14 MATERIAL SUBSTITUTIONS

A. Materials proposed for use in the performance of the work that are not specified herein must be submitted to the Owner/Owner's Representative for evaluation no later than ten days prior to bid.

PART 2 PRODUCTS

2.1 GENERAL

A. The products herein specified are totally pre-engineered products of the listed manufacturer and establish criteria for the approval of substitutions. Products must be part of a virtually odorless, pre-engineered, low-VOC, fully-reinforced, cold-fluid-applied liquid waterproofing membrane system, equivalent in function, quality, composition and method of application to be considered for approval as an "Approved Substitute". Substitute materials must meet or exceed the physical performance characteristics of the specified materials..

2.2 MANUFACTURERS - MEMBRANE

A. The products herein specified are totally pre-engineered products of the listed manufacturer and establish a criteria for approval of substitutions if allowed. Products must be part of a pre-engineered system, equivalent in function, quality, composition and method of application to be considered for approval as an "Approved Substitute".

B. Membrane

1. Two-component cold fluid-applied PMMA (polymethyl-methacrylate) membrane reinforced with non-woven polyester reinforcing fabric, for a finished dry film membrane thickness of .080 inch nominal; with integral color throughout as selected by owner from manufacturer's standard palette of colors; conforming to ASTM C 836. Subject to compliance with requirements, provide products manufactured and supplied by the following:

C. Waterproofing Membrane:

1. ALT R230 Roofing and Waterproofing System, manufactured by ALT Global, LLC. or approved equal.

D. Flashing Membrane:

1. ALT R230 Thixo Flashing System, manufactured by ALT Global, LLC.

E. Aesthetic Finish and/or Slip Resistant Topcoat:

1. ALT Finish 288 or ALT R/RS291 Textured Finish, manufactured by ALT Global, LLC/WestWood.

2.3 INSULATION COVER BOARD

A. Cover Board (Durock and Permabase): High compressive strength underlayment board consisting of aggregated Portland cement slurry with polymer-coated glass fiber mesh, with the following characteristics:

1.	Board Weight	3.0 lb/sq. ft.
2.	Board Size	48 x 96 inches.
3.	Board Thickness	1/2 inch.
4.	Thermal Conductivity	K factor of 1.92 as determined by ASTM C 177.
5.	Board Edges	Square

2.4 INSULATION

A. Polyisocyanurate insulation board having non-asphaltic facers meeting or exceeding the requirements for Fed. Spec. HH-I-1972/Gen., with minimum compressive resistance of 18 psi, 1.0 inch minimum thickness, with the following characteristics:

1.	Board Density	2.0 lb/cu. ft.
2.	Board Size	48 x 96 inches.
3.	Board Thickness	2 inches.
4.	Thermal Conductivity	K factor of 0.17 as determined by ASTM C 177, aged 12 months at 75 degrees.
5.	Board Edges	Square

2.5 TAPERED INSULATION

A. Tapered polyisocyanurate insulation board having non-asphaltic facers meeting or exceeding the requirements for Fed. Spec. HH-I-1972/Gen., with minimum compressive resistance of 18 psi, 1.0 inch minimum thickness, with the following characteristics:

1.	Board Density	2.0 lb/cu. ft.
2.	Board Size	48 x 96 inches.
3.	Board Taper	1/4 inch per foot
4.	Total Thickness	1/2 inch minimum
5.	Thermal Conductivity	K factor of 0.17 as determined by ASTM C 177, aged 12 months at 75 degrees.
6.	Board Edges	Square

2.6 SUBSTRATE BOARD

A. Provide Dens Deck as manufactured by Georgia-Pacific Corp., or equivalent, conforming to ASTM C 1177, glass-mat, water-resistant gypsum substrate, thickness as indicated.

2.7 BASE/ CAP SHEET AND INSULATION SECUREMENT

A. Polyurethane Adhesive (Insulation and Cover Board): FM-approved single-component, moisture-cured polyurethane adhesive. Adhesive application rate shall be in accordance with specified wind uplift rating for system application. Roofing adhesive shall be a type approved by membrane and insulation manufacturer. NOTE: Prior written approval by the adhesive, insulation and membrane manufacturers for use of polyurethane roofing adhesive must be obtained.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck/substrate openings, curbs, and protrusions through deck/substrate, wood cant strips and reglets are in place and solidly set.

C. Verify deck/substrate is structurally supported, secure and sound.

3.2 PREPARATION OF SUBSTRATE

A. General:

1. All substrates must be free from gross irregularities, loose, unsound or foreign material such as dirt, ice, snow, water, grease, oil, release agents, lacquers, or any other condition that would be detrimental to adhesion of the primer and/or resin to the substrate. All surfaces will require scarifying, sandblasting or grinding to achieve a suitable substrate as acceptable to the Membrane Manufacturer.

2. Inspect all substrates, and correct defects before application of new waterproofing. Fill all surface voids greater than 1/16 inch (1.5 mm) wide and/or deep with fill material acceptable to the Membrane Manufacturer.

3. Substrate shall have a maximum moisture content of six (6) percent or 75% relative humidity, and be prepared as required to provide adhesion of the membrane to substrate with a minimum bond strength of 116 psi (0.8 N/mm^2) for roofing applications.

4. Determinations of surface preparation indicated by bond strength and moisture content testing shall be periodically performed and recorded by the Contractor throughout the course of work. Test results shall be submitted in writing to the Owner or his designated Representative and Membrane Manufacturer for acceptance.

5. The final substrate shall be clean, dry, and free of contaminants.

B. Concrete:

1. New or existing concrete shall be free of sharps, projections, spalls, oil, grease, curing compounds, loose particles, moss, algae growth, latence, friable matter, dirt, and previous waterproofing materials.

2. All concrete and concrete repair materials must be cured a minimum of 28 days in accordance with ACI-308, or as recommended by the concrete/mortar manufacturer, in order to achieve a minimum hardness of 3,500 psi (25 N/mm^2) with a maximum moisture content of six (6) percent or 75% relative humidity.

3. Concrete shall be abrasively cleaned in accordance with ASTM D4259 to provide a sound substrate free from latence with an open abraded surface. When using mechanical methods to remove existing waterproofing products or surface deterioration, the surface profile shall be in accordance with ICRI (International Concrete Repair Institute) Technical Guideline 03732, CSP-3, CSP-4, or CSP-5.

4. Areas of spalls, voids, bug holes and other deterioration on vertical or horizontal surfaces shall be repaired in accordance with the requirements of the Membrane Manufacturer and the Owner or his designated Representative.

C. Masonry Construction:

1. Walls shall be built with hard kiln dried brick, reinforced concrete block, or waterproof concrete block construction with a maximum moisture content of six (6) percent or 75% relative humidity.

2. Flashings must not be applied over soft or scaling brick or block, faulty mortar joints, or walls with broken, damaged or leaking coping. Areas of spalls, voids, bug holes and other deterioration on vertical surfaces shall be repaired in accordance with the requirements of the Membrane Manufacturer and the Owner or his designated Representative.

3. Walls of ordinary hollow tile, or other materials which in themselves are not waterproofed, should not be accepted as suitable to receive flashings unless they are properly waterproofed, to prevent moisture infiltration from above or behind the new waterproofing membrane and flashings.

D. Steel/Metal:

1. All metal surfaces shall be cleaned in accordance with SSPC - SP3, abraded, and wiped with solvent as required by Membrane Manufacturer. Extend preparation maximum 1/8 inch (3 mm) beyond the specified termination of the membrane flashing materials and notch to provide a rust-stop where required.

E. Other Flashing Surfaces:

1. Remove all contaminants and prepare substrate as required by Membrane Manufacturer and the Owner or his designated Representative.

3.3 PRIMER APPLICATION

A. Apply appropriate proprietary fast-curing primer on all substrates as required or recommended by the cold fluid-applied Membrane Manufacturer.

B. For substrates requiring metal primer, apply single component fast-curing primer with a brush or lambswool roller at the minimum consumption of 0.17 - 0.2 kg/m^2 or as recommended by the Membrane Manufacturer and allow to cure as required depending upon temperature.

C. For substrates requiring standard primer, apply two component fast-curing MMA primer with a lambswool roller at the minimum consumption of 0.037 kg/sf (0.4 kg/m^2) or as recommended by the Membrane Manufacturer and allow to cure for 45 minutes minimum.

3.4 SUBSTRATE LEVELING & REPAIR

A. Provide Manufacturers proprietary ALT RS233 or ALT RS242 resin-mortar for leveling, patching and repairs of all traffic bearing substrates as recommended by the Membrane Manufacturer.

B. Provide Manufacturers proprietary ALT R290 Paste or ALT RS242 resin-mortar for leveling, patching and repairs of all non-traffic bearing horizontal or vertical substrates as recommended by the Membrane Manufacturer.

C. Resin-mortar should be placed after priming substrate with Membrane Manufacturers proprietary primer and in lifts no greater than the maximum thicknesses indicated by the Membrane Manufacturer. Trowel into place and allow to harden. If additional lifts will be required, broadcast top surface of the placed resin-mortar with clean dry 0.7 - 1.2 mm quartz silica at approximately 25% coverage while the resin-mortar is wet. Place next lift once the resin-mortar has cured.

3.5 MEMBRANE INSTALLATION & STAGING

A. In a normal cold fluid-applied membrane application the substrate is prepared and primed, flashings are installed first, followed by the application of the field membrane.

B. If work is interrupted for more than 12-hours, use Membrane Manufacturer=s proprietary cleaner/activator to clean and reactivate applied primer, resin or membrane transition areas. Activator should be allowed a minimum of 20-minutes evaporation time after application and covered within 60-minutes of application or as recommended by the Membrane Manufacturer.

C. For all tie-in locations, provide a minimum overlap of 4 inches (10 cm), reinforcing and resin.

3.6 FLASHING MEMBRANE APPLICATION

A. General:

1. Install all flashings in accordance with details or as recommended by Membrane Manufacturer.

2. Provide minimum vertical height of 8 inches (20 cm) for all flashing terminations wherever possible. Flashing height shall be at least as high as the potential water level that could be reached as a result of a deluging rain and/or poor slope.

3. Do not flash over existing through-wall flashings, weep holes and overflow scuppers.

4. All flashing shall be terminated as required by the Membrane Manufacturer. Cap flashings or counter flashings may be constructed of metal, stone, tile or other materials properly installed in accordance with industry-accepted practice.

B. Liquid Applied Flashing:

1. Mix and apply cold fluid-applied reinforced membrane flashing in strict accordance with written instructions of Membrane Manufacturer.

2. Using a lambswool roller, apply an even layer of cold fluid-applied resin at the minimum consumption of 0.2 kg/ft^2 (2.3 kg/m^2) or as recommended by the Membrane Manufacturer and allow to cure for 45 minutes minimum.

3. Work Membrane Manufacturer=s proprietary reinforcement into the wet resin, removing trapped air, using the lambswool roller. Maintain 2-inches (5 cm) minimum overlap at all side and butt laps of reinforcement and extend flashing a minimum of 4-inches (10 cm) horizontally onto deck.

4. Apply an even topcoat of cold fluid-applied resin at the minimum consumption of 0.09 kg/ft^2 (1.0 kg/m^2) or as recommended by the Membrane Manufacturer.

5. Allow completed membrane to cure as recommended by the Membrane Manufacturer prior to continuing application or applying loads. Fluid-applied membrane must be rainproof after approximately 60-minutes, and capable of carrying a load, i.e., be walked-on, in approximately 2-hours.

C. Penetrations

1. Pipes, Conduits, and Unusual Shaped Penetrations:

   a. Pipes conduits and other items to be flashed must be separated with 1-inch (2.54 cm) minimum clearance or as recommended by Membrane Manufacturer to adequate waterproof each individual penetration.
   b. All penetrations must be flashed individually. Two or more items ganged together in a flashing will NOT be permitted.
   c. Flash penetrations using cold fluid-applied reinforced membrane or Membrane Manufacturers proprietary flashing matrix as recommended. Flashing shall consist of a reinforced deck skirt/target flashing and reinforced vertical wrap.

D. Roof Drains:

1. Flash roof drains using cold fluid-applied membrane. Flashing shall consist of target flashing extending minimum 12-inches (30 cm) horizontally onto the substrate and extend down into the prepared drain bowl a minimum of 3-inches (7.5 cm).

2. At no time should the cold fluid-applied membrane be installed to restrict or reduce the drain inlet in size.

3. For new roof drains, Contractor shall include cost of all plumbing work, piping and connection to existing storm sewer system.

E. Hot Pipes:

1. Protect cold fluid-applied membrane components from direct contact with steam or heat sources when the in-service temperature exceeds 150 degrees F. In all such cases flash to an intermediate "cool" sleeve.

2. Fabricate "cool" sleeve in the form of a metal cone using galvanized metal in accordance with membrane manufacturer details.

3. Flash sleeve using cold fluid-applied reinforced membrane or Membrane Manufacturers proprietary flashing matrix as recommended. Flashing shall consist of a reinforced deck skirt/target flashing and reinforced vertical wrap.

F. Flexible Penetrations

1. Provide a weather-tight gooseneck set in Membrane Manufacturer=s acrylic resin paste and secured to the deck.

2. Flash gooseneck penetrations using cold fluid-applied reinforced membrane or Membrane Manufacturers proprietary flashing matrix as recommended. Flashing shall consist of a reinforced deck skirt/target flashing and reinforced vertical wrap.

G. Walls, Curbs and Bases:

1. Flash all walls, curbs and base flashings using cold fluid-applied reinforced membrane. Wherever possible extend flashing up and over tops of walls, curbs and bases so the membrane terminates on the opposite vertical face of the building element.

H. Expansion Joints:

1. Flash all expansion joints with two layers of cold fluid-applied reinforced membrane applied over an expansion bellows and/or bond breaker tape as required.

3.7 ROOF MEMBRANE APPLICATION

A. Mix and apply cold fluid-applied reinforced roofing membrane in strict accordance with written instructions of Membrane Manufacturer.

B. Using a lambswool roller, apply an even layer of cold fluid-applied resin at the minimum consumption of 0.21 kg/ft^2 (2.3 kg/m^2) or as recommended by the Membrane Manufacturer and allow to cure for 45 minutes minimum.

C. Work Membrane Manufacturer=s proprietary reinforcement into the wet resin, removing trapped air, using the lambswool roller. Maintain a minimum 2-inch (5 cm) overlap at all side and butt laps of adjacent reinforcement rows. Maintain a minimum 4-inch (10 cm) overlap at all flashings and penetrations.

D. Apply an even topcoat of cold fluid-applied resin at the minimum consumption of 0.09 kg/ft^2 (1.0 kg/m^2) or as recommended by the Membrane Manufacturer.

E. Allow completed membrane to cure as recommended by the Membrane Manufacturer prior to continuing application or applying loads. Fluid-applied membrane must be rainproof after approximately 60-minutes, and capable of carrying al load, i.e., be walked-on, in approximately 2-hours.

3.8 INSULATION/COVER BOARD INSTALLATION

A. General: Insulation and cover board shall be installed in accordance with the insulation/cover board manufacturer's current published specifications and recommendations for use with adhered roofing.

B. Install Insulation/Cover Board: Install only as much insulation and cover board as can be primed, sealed, and protected before the end of the day's work or before the onset of inclement weather.

C. Fit Insulation/Cover Board: Neatly fit insulation/cover board to all penetrations, projections, and nailers. Insulation shall be loosely butted, with gaps not greater than 1/4". All gaps greater than 1/4" shall be filled with acceptable insulation. Cover board shall be loosely butted, with gaps not greater than 1/4". All gaps greater than 1/8" shall be filled with primer; all gaps greater than ¼" shall be filled with polyurethane sealant.

D. Strip In Cover Board Joints: Strip all cover board joints with four inch (4") wide strip of flashing membrane. Under no circumstances shall the membrane be left unsupported over a space greater than 1/4".

E. Stagger Insulation/Cover Board Joints: When installing multiple layers of insulation, all joints between succeeding layers shall be staggered a minimum of 6" in each direction.

F. Steel Deck Substrates: Place boards perpendicular to steel deck flutes with edges over flute surface for bearing support. Edges shall be checked so that no edges are left substantially unsupported along the flutes.

G. Drain Sumps: Insulation shall be feathered or tapered to provide a sump area a minimum of 36" x 36" where possible at all drains. Taper insulation around roof drains so as to provide proper slope for drainage. In areas where feathered or tapered insulation leaves insulation core exposed, cover with an appropriate cover board or base sheet/cap sheet assembly to provide a sound and smooth substrate surface.

H. Tapered Insulation: Place the constant thickness first layer and the tapered thickness insulation to the required slope pattern in accordance with insulation manufacturer's instructions.

I. Polyurethane Adhesive Attachment: Follow insulation/cover board and adhesive manufacturers' recommendations for the appropriate adhesive application rate and application procedure. Under normal application rate, dispense the first bead 3" inside the outside edges of the insulation/cover board to be attached, with sequential beads equidistant. Place the boards onto the roofing adhesive beads. Walk on the boards to spread the roofing adhesive for maximum contact. Periodically walk on the boards until firmly attached. Reference FM approvals for adhesive application patterns that satisfy FM wind uplift requirements. Typical application is a 3/4" bead of roofing adhesive at a rate of one lineal foot per square foot of insulation/cover board to be attached. Note: additional adhesive is required in the corner and perimeter regions of the roof. Secure insulation/cover board in accordance with approval requirements.

3.9 PMMA SURFACING & FINISHES

A. Where specified or required for walkways, anti-slip surfacing, and/or aesthetic treatment provide and install Membrane Manufacturers proprietary aesthetic PMMA topcoat finish, aesthetic topcoat finish mixed with anti-slip additive, extured finish with integrally blended aggregate, or using topcoat finish broadcast with medium grain aggregates. A combination of colored aggregates or pigmented finish may be used to create a variety of aesthetic treatments.

B. Textured Finish

1. Finish:

a. Apply Membrane Manufacturers proprietary aesthetic cold fluid-applied pigmented resin topcoat finish using a hard rubber squeegee and a lambswool roller apply an even layer of cold fluid-applied resin at the minimum consumption of 0.046 kg/ft^2 (0.5 kg/m^2) or as recommended by the Membrane Manufacturer and allow to cure for 45 minutes minimum.
b. Finish topcoat should be rainproof after approximately 30-minutes, and can be walked-on in approximately 2-hours.

3.10 MEMBRANE FLOOD TESTING

A. Flood testing is required for all waterproofing applications to be covered with overburden. Prior to applying overburden, flood test all horizontal applications with a minimum 2" (51 mm) head of water for 24 hours. Mark any leaks and repair when the membrane is dry. Before flood testing, be sure the structure will withstand the dead load of the water. For well-sloped decks, segment the flood test to avoid deep water near drains.

B. Conduct the flood test 1-day after completing the waterproofing membrane application. Immediately after the flood test and all necessary repairs are made, install overburden to protect waterproofing membrane from damage by other trades.

3.11 CLOSEOUT

A. Correction of Work: Work that does not conform to specified requirements including tolerances, slopes, and finishes shall be corrected and/or replaced. Any deficiencies of membrane application, termination and/or protection as noted during the membrane manufacturer's inspections shall be corrected and/or replaced at Contractor's expense.

B. Clean-Up: Site clean-up, including both interior and exterior building areas that have been affected by construction, shall be restored to preconstruction condition.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sheet metal flashing as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Stainless steel flashing.
2. Aluminum flashing.
3. Field fabricating (including bending, cutting, soldering, etc.), if required, of flashing.
4. Separation of contacting surfaces of dissimilar metals.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Exterior Stone Cladding - Section 044200.

C. Cast Stone - Section 047200.

D. Roofing - Division 7.

1.4 SUBMITTALS

A. Shop Drawings: Submit, showing all materials, finishes, fastenings, joint details, fabrication, construction and relation to adjoining construction.

B. Samples: Submit 12" x 12" samples of flashing materials and finishes.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

1.6 WARRANTY

A. The Contractor shall warrant that all Metal Flashing Work executed under this Section will be free from defects in materials and workmanship for a period of ten (10) years from date of acceptance of the Project, and he shall remedy any defects in the Metal Flashing Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel Flashing Materials

1. Stainless Steel Flashing: ASTM A 240, Type 304, stainless steel, with 2D finish, dead soft temper, fully annealed, as manufactured by International Nickel Co., Republic Steel Corp., United States Steel, or Washington Steel Corp. Thickness of stainless steel shall be as listed below.

a. Concealed Flashings: 0.012" thick, thirty (30) gauge (U.S. Standard).
b. Exposed Flashings: 0.015" thick, twenty-eight (28) gauge (U.S. Standard).
c. Edge Strips: 0.025" thick, twenty-four (24) gauge (U.S. Standard).

2. Through-wall flashing shall have sawtooth ribs at three (3) inch intervals, as manufactured by Keystone Flashing Co., or approved equal.

3. Accessories and Fastenings: AISI, Types 302 and 304 stainless steel.

4. Solder: Composed of sixty (60) percent block tin and forty (40) percent pig lead, except that solder at seams exposed to public view shall be eighty (80) percent tin and twenty (20) percent lead.

5. Flux: An acid type flux manufactured specifically for soldering stainless steel, as approved.

B. Aluminum Flashing: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; mill finish for concealed flashing; 0.063" thick.

1. Accessories and Fastenings: AISI, Types 302 and 304 stainless steel, or aluminum.

2. Exposed Coil-Coated Finish

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 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.
b. Color: Custom color as selected by the Architect.

C. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where sheet metal flashing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 METAL FLASHING INSTALLATION

A. Reference Standard: Conform to the requirements of 7th Edition of the Sheet Metal and Air Conditioning Contractors Association (SMACNA) Architectural Sheet Metal Manual.

B. General: Fabricate and install metal flashing work in accordance with details and specifications of above Reference Standard, with manufacturer's instructions, and as herein specified, to provide a watertight installation. Apply metal flashing to smooth, even, sound, clean, dry surfaces free from defects. Make provisions to allow for expansion and contraction of metal flashing work. Wherever practicable, shop form all metal flashing work and deliver ready for installation. Form metal flashing work accurately to required profiles, with flat surfaces, straight edges and corners, free from defects. Fold exposed metal edges back not less than 1/2" and form drip.

C. Nailing: Confine to sheets twelve (12) inches or less in width. Confine nailing to one edge only, locate nails where concealed. Use No. 12 x 1" long flat headed, annular threaded, Type 302 stainless steel nails for nailing to wood blocking; use one (1) inch long masonry nails for nailing to concrete. Space nails four (4) inches o.c. maximum.

D. Cleating: Use cleats where sheets are more than twelve (12) inches in width. Space cleats approximately twelve (12) inches o.c. Cleats two (2) inches wide by three (3) inches long, of the same material and weight as the metal flashing being installed. Secure one end of the cleat with two (2) nails and fold edge back over the nail heads. Lock other end into seam or into folded edge of metal flashing sheets. Pre-tin cleats for soldered seams.

E. Joining: Join metal flashings with one (1) inch locked and soldered seams except at slip joints. Mallet seams flat and solder full length of seam as specified below.

F. Soldering: Clean and pre-tin edges of metal flashing to be soldered before soldering is begun with solder on both sides for a width of not less than 1-1/2". Solder slowly with well heated metal surfaces. Use ample solder. Show not less than one full inch of evenly flowed solder on seam. Seams shall have a liberal amount of flux brushed in before soldering is commenced. Where soldering paste or killed acid is employed as a flux, soldering shall follow immediately after application of the flux. Upon completion of soldering, clean surfaces of all flux.

G. Slip Joints: Locate slip joints not more than twenty-four (24) feet apart and not more than eight (8) feet from corners. Form slip joints as three (3) inch wide joints with cover piece behind flashing and fill locked ends neatly with sealant.

H. Cap Flashing: Install over base flashings, in eight (8) to ten (10) foot lengths, lapped six (6) inches at ends. Cap flashing shall be increased longitudinally to produce spring action to hold bottom edge of cap flashing firmly against base flashing. Cap flashing shall lap base flashing at least four (4) inches, with exposed bottom edge at a forty-five (45) degree angle downward and folded back on underside at least 1/2" to form drip. Make cap flashing continuous at corners and angles.

I. Miscellaneous Flashing: Provide all other miscellaneous metal flashing not specifically mentioned herein but indicated on drawings and/or required to provide a watertight installation.

J. Separation of Dissimilar Materials: Back paint surfaces of metal flashing in contact with dissimilar metals or with concrete or masonry with bituminous paint.

END OF SECTION

SECTION 077100 - ROOF SPECIALTIES AND ACCESSORIES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the roof specialties and accessories as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Roof hatches.
2. Prefabricated roof curbs.
3. Aluminum scuppers and downspouts.

1.3 RELATED SECTIONS

A. Roofing - Division 7.

B. Sheet Metal Flashing - Section 076200.

C. Metal-Framed Skylight - Section 086300.

1.4 SUBMITTALS

A. Before any roof specialties and accessories are delivered to the job site, submit shop drawings showing profiles and anchoring devices.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 ROOF HATCH

A. Provide thermally broken shop-primed, galvanized steel roof hatch units of sizes shown on drawings, with 1" rigid insulation at curbs and door and standard self-lifting mechanism. Provide manufacturer's standard hardware, including hold-open device, hinges, latch, and operating handles for inside operation. Construct units for 40 lbs. per sq. ft. live load.

B. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

1. Height: 42 inches above finished roof deck.

2. Test load per code requirements.

3. Provide self-latching gate fabricated of same materials as safety railing system.

C. Provide units manufactured by Bilco, Babcock-Davis, Milcor or approved equal.

2.2 PREFABRICATED ROOF CURBS

A. Provide manufacturer's standard shop fabricated units made of 14 ga. zinc coated steel factory primed with rust inhibitive primer and insulated with 1-1/2" thick fiberglass board. Provide units manufactured by Pate, Louvers & Dampers, Inc., Industrial Louvers, Inc., or approved equal.

B. Reinforce units over 8'-0" long and units requiring reinforcement due to heavy loads by forming units of double-walled box-type construction with stiffeners of heavy gauge with flanges as required to provide sufficient rigidity and strength to withstand max. lateral forces in addition to super imposed vertical loads.

C. Provide treated wood nailer, not less than 1-5/8" thick and of the width shown, but not less than the width of the curb wall assembly. Anchor nailer securely to the top of the metal frame unit. Refer to Section 062000 of these specifications for pressure-treatment required for wood nailers.

D. Provide 22 ga. galvanized steel curb liners; where required extend curb liners through deck construction to coordinate with work below.

E. Provide 18 ga. galvanized steel cap flashing to cover a min. of 3" over roof flashing.

F. Where curb units are shown to support shop fabricated items of equipment, do not proceed with fabrication of curb units until size or dimensions have been checked for coordination with equipment.

2.3 ALUMINUM SCUPPERS AND DOWNSPOUTS

A. Downspouts: Provide aluminum downspouts fabricated of formed aluminum, 0.050" thick, alloy 5005-H154, smooth, no pattern. Downspout shall be manufactured in 10'-0" lengths, rectangular closed-face with mitered elbows, factory offset on one end to provide for a 3/4" telescope joint. Downspout shall contain a factory mounted back, non-sealed to allow seepage of water in overflow conditions.

1. Elbows for downspouts shall be of welded construction, with matching finish applied after welding. Such finish shall be of quality equal to finish for non-welded parts. Grinding and spray painting of parts to match will not be permitted. Elbows shall be provided with a factory offset on its lower end to allow a 3/4" telescope joint.

2. Provide manufacturer's standard wall brackets of compatible material to downspout with matching finish and color.

B. Scuppers: Manufactured scuppers with closure flange trim to exterior, 4" wide wall flanges to interior, and base extending 4" beyond cant or tapered strip onto field of roof. Manufacture from 0.0320" thick aluminum.

C. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roof specialties and accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and with roof insulation, roofing and flashing; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation: Where metal surfaces of units are to be installed in contact with non-compatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

D. Operational Units: Test operational units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

E. Downspouts

1. Install downspouts with brackets 24" o.c.; attach brackets to structure, use non-corrosive screw anchors.

2. Join sections with manufacturer's standard telescoping joints. Provide fasteners designed to hold downspouts securely 1" away from walls, locate fasteners at top and bottom and at approximately 60" o.c. in between. Provide elbows at base of downspout to direct

water away from building or downspout boots to connect exposed downspout to underground cast iron soil piping.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 077600 - ROOF PAVERS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the roof pavers as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Rubber pavers.

1.3 RELATED SECTIONS

A. Roofing - Division 7.

B. Drains - Division 22.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain each color, type, and variety of paver from a single source with resources necessary to provide products and materials of consistent quality in appearance and physical properties without delaying progress of the Work.

1.5 SUBMITTALS

A. Product Data: For each type of paver and accessory indicated.

B. Shop Drawings: Provide typical installation details, showing details at drains, reinforcing flashings, terminations, penetrations in membrane systems, and layout of pavers and installation details for pavers.

C. Samples: For each type of paver finish required and for each type of paver accessory indicated. Provide full-size samples of pavers to adequately show color.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect pavers during storage and construction against wetting by rain, snow, or ground water, and against staining or contamination from earth and other materials.

1.7 EXTRA STOCK

A. Upon completion of this portion of the Work, deliver to the Owner an extra stock of pavers, pedestals, and accessories of ten percent of each product and finish. All extra stock shall be new, in original packaging, and clearly labeled.

PART 2 PRODUCTS

2.1 ROOF PAVERS

A. Rubber pavers shall be 3-1/2" thick, 44" x 22" interlocking rubber pavers fabricated from recycled tires and rubber granules equal to "Softland" made by Unity Surfacing Systems in color selected by the Architect.

B. Pavers shall be fully adhered to substrate at perimeter using adhesive recommended by the paver manufacturer and approved by the roof manufacturer.

C. Installer of pavers shall provide engineering to meet wind uplift requirements per New York State Building Code.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roof pavers are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 LAYOUT

A. Lay out roof pavers so as not to obstruct drainage paths or drains.

B. Start paver layout at center of roof sections in such a way as to avoid pavers of less than one-half width at edges or other joints with vertical obstructions.

3.3 INSTALLATION

A. General: Install roof pavers according to manufacturer’s written instructions. Use shims, separators, and other miscellaneous items as required for completing roof paver installation. Install roof pavers to resist exposure to weather without failing, shifting, and disengagement.

B. Cracked, broken or otherwise damaged pavers must be removed and discarded, and replaced with undamaged units. Cut and fit pavers neatly around all penetrations and projections, and at the perimeter, achieving a 1" maximum gap.

C. Comply with DOW TechNote 508 for wind uplift.

END OF SECTION

SECTION 078100 - SPRAYED FIRE-RESISTIVE MATERIALS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sprayed fire-resistive materials as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Spray-on fireproofing for structural steel and metal decking.
2. Seal coat over fireproofing in special areas.
3. Preparation of surfaces.
4. Field quality control.

1.3 RELATED SECTIONS

A. Structural Steel – Section 051200.

B. Steel Decking – Section 053100.

C. Firestops and Smokeseals – Section 078413.

1.4 SUBMITTALS

A. Product Data: For each fire-resistive product specified.

B. Shop Drawings: Submit structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
    a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
    b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
3. Identify restrained and unrestrained assemblies on shop drawings, show required thickness of fireproofing for each assembly.

C. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. 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.

F. If primer is to be used steel and/or metal deck, submit certifications by supplier of primer that primer is compatible with materials, and will not impair the required performance of the installed fireproofing. Such certification shall be accompanied by evidence that the primer was successfully used in conjunction with the fireproofing material in a UL test applicable to the construction. Submit certification prior to application of primer.

1. Coordinate with Section 051200 "Structural Steel," 053100 "Steel Deck," and Structural Drawings prior to application of primer.

G. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.

H. Code Compliance: Proposed product must comply with prevailing Building Code and be approved by those individuals having jurisdiction.

I. Letter from manufacturer stating that the UL Design selected for the project is not load restricted.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Submit data indicating that products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

C. Mockups: After processing of initial submittals and before delivery and installation of fireproofing materials, prepare a sample installation of fireproofing work, approximately 100 sq. ft. in area; providing an example of each type required, applied on each different substrate, to produce each different rating as required and reasonably representative of entire sprayed on fireproofing work, for joint approval by representative of fire resistant material manufacturer and Owner. Work in other areas shall not proceed until mock-up has been completed. Mock-up work which remains in compliance with requirements and is in undamaged and acceptable condition may be retained as final work in place.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 deg F. or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material to achieve a minimum of four air changes per hour. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 SEQUENCING

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.

2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material. Fireproofing shall be considered dry when the moisture content is 6% or less.

4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.

6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

7. Protect permanently exposed walls, floor, or special surfaces.

1.9 WARRANTY

A. General Warranty: 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. Special Warranty: Submit a written warranty, executed by Contractor and cosigned by Installer, agreeing to repair or replace sprayed fire-resistive materials that fail within the specified warranty period.

1. Failures include, but are not limited to, cracking, flaking, eroding in excess of specified requirements; peeling; and delaminating of sprayed fire-resistive materials from substrates due to defective materials and workmanship within the specified warranty period.

2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

C. Warranty Period: Three (3) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

B. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor will not be allowed.

C. Material Composition: Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

D. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: Minimum 15 lb./cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design shown on approved submittals.

a. Fireproofing shall be of thicknesses and density to meet the requirements of the New York State Building Code for type of construction indicated for the Project.

3. Bond Strength: Not less than 200 lbf/sq. ft. per ASTM E 736.

4. Compressive Strength: 5.21 lbf/sq. in. as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb./cu. ft.

5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.

6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.

7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.

8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb./cu. Ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Flame Spread: 10 or less.
    b. Smoke Developed: 0.

10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

E. Products: Subject to compliance with requirements, provide products by one of the following:

1. Cementitious Sprayed Fire-Resistive Material

    a. Type 5GP; SouthWest, Carboline.
    b. Monokote Type MK-6; GCP Applied Technologies.
    c. Cafco 300; Isolatek International Corp., Cafco Products.
    d. Type F3; Promat Firetemp.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.

B. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material, used where required by manufacturer to insure proper bond.

C. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

D. Sealer for Sprayed Fire-Resistive Material in Elevator Shafts and Open Area Plenums: Transparent-drying, water-dispersible protective coating by manufacturer of fire-resistive material.

1. Product: Subject to compliance with requirements, provide "Firebond Concentrate" by GCP Applied Technologies, or similar product recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:

1. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.

2. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

3. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

C. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.

D. Extend fire-resistive material in full thickness over entire area of each substrate to be protected.

E. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by method recommended by the manufacturer.

F. Where sealers are used, apply products that are tinted to differentiate them from the sprayed fire-resistive material over which they are applied.

G. Maintain ambient conditions during installation and for cure period following installation, as recommended by manufacturer. Provide ventilation and avoid excessive rate of drying.

H. Fireproofing to the underside of roof deck assemblies shall be done only after roofing application is complete, all roof mounted mechanical equipment is in place, and the roof is watertight.

I. No fireproofing shall be applied prior to completion of concrete work on steel decking.

J. Installation Sequence of Fireproofing: All patching and repairing of sprayed fireproofing, due to cutting by other trades or testing and inspection, shall be performed under this Section.

K. Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. For each 1000-sq. ft. area, or partial area, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.

a. Thickness for Floors, Roofs, and Walls: From the average of 10 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.

2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.

3. For each 10,000 sq. ft. area, or partial area, on each floor, testing and inspection agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire resistance design.

a. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.

4. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

5. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.

D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

C. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.

1. Patch and repair fireproofing where Owner’s Testing Agency has performed tests.

D. Repair or replace work that has not been successfully protected.

END OF SECTION

SECTION 078413 - FIRESTOPS AND SMOKESEALS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the firestops and smokeseals as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire-resistance-rated construction.

5. Penetrations at each floor level in shafts and/or stairwells.

6. Construction joints, including those between top of fire rated walls and underside of floors above.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Joint Sealants - Section 079200.

D. Gypsum Drywall - Section 092900.

E. Piping penetrations - Division 22.

F. Duct penetrations - Division 23.

G. Cable and conduit penetrations - Division 26.

1.4 REFERENCES

A. ASTM E 814 "Standard Method of Fire Tests of Through-Penetration Firestops."

B. UL 1479, UBC 7-5 (Both are same as A. above).

C. ASTM E 136 "Standard Test Method for Assessing Combustibility of Materials."

D. UL 263, UBC 7-1 "Fire Tests of Building Construction and Materials"

E. UL 2079 "Tests For Fire Resistance of Building Joint Systems."

F. ASTM E 1399 "Test For Dynamic Movement Conditions."

G. ASTM E 1966 (Same as E. above).

H. ASTM G 21 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi."

I. Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus."

J. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Firestops."

K. Published Through-Penetration Systems by recognized independent testing agencies.

1. UL Fire Resistance Directory, Volume II of current year.

2. Warnock Hersey Certification Listings, current year.

3. Omega Point Laboratories, current year.

L. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

1.5 SUBMITTALS

A. Submit manufacturer's product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance, limitation criteria, test data and indication that products comply with specified requirements.

B. Submit shop drawings detailing materials, installation methods, and relationships to adjoining construction for each firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspection agency evidencing compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, for proposed UL listed (or equal) firestop and smokeseal assembly required for the Project.

C. Material Safety Data Sheets: Submit MSDS for each firestop product.

D. Submit qualifications of firestop installer, including letter from firestop manufacturer of products proposed to be installed, wherein manufacturer approves or recognizes as trained/ or certifies installer for installation of that manufacturer's products.

E. Engineering Judgment: For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having

jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

1.6 QUALITY ASSURANCE

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire and the passage of smoke and other gases.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

C. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E 814 or UL 1479. The F-rating must be a minimum of one (1) hour, but not less than the fire resistance rating of the assembly being penetrated. T-rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

1. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

    a. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
    b. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
    c. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

2. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

    a. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

D. Firestopping products shall be asbestos free and free of any PCBs.

E. Do not use any product containing solvents or that requires hazardous waste disposal.

F. Do not use firestop products which after curing, dissolve in water.

G. Do not use firestop products that contain ceramic fibers.

H. Firestopping Installer Qualifications: Firestop application shall be performed by a single firestopping contractor who specializes in the installation of firestop systems, whose personnel to be utilized have received specific training and certification or approval from the proposed respective firestop manufacturer, and firestop installer shall have a minimum of three years' experience (under present company name) installing firestop systems of the type herein specified.

I. Mock-Up: Prepare job site mock-ups of each typical Firestop System proposed for use in the project. Approved mock-ups will be left in place as part of the finished project and will constitute the quality standard for the remaining work.

J. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

K. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of less than or equal to 1 as determined by ASTM G 21.

L. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post-installed." Provide cast-in-place firestop devices prior to concrete placement.

M. Firestop systems do not reestablish the structural integrity of load bearing partitions or assemblies, or support live loads and traffic. Installer shall consult the Structural Engineer prior to penetrating any load bearing assembly.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with manufacturer's name, product identification, lot numbers, UL or Warnock Hersey labels, and mixing and installation instructions, as applicable.

B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturer.

C. All firestop materials shall be installed prior to expiration of shelf life.

1.8 PROJECT CONDITIONS

A. Verify existing conditions and substrates before starting work

B. Do not use materials that contain solvents, show sign of damage or are beyond their shelf life.

C. During installation, provide masking and drop cloths as needed to prevent firestopping products from contaminating any adjacent surfaces.

D. Conform to ventilation requirements if required by manufacturer's installation instructions or Material Safety Data Sheet.

E. Weather Conditions: Do not proceed with installation of firestop products when temperatures are in excess or below the manufacturer's recommendations.

F. Schedule installation of firestop products after completion of penetrating item installation but prior to covering or concealing of openings.

G. Coordinate this work as required with work of other trades.

1.9 SEQUENCING AND SCHEDULING

A. Pre-Installation Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

B. Sequence: Perform work of this and other sections in proper sequence to prevent damage to the firestop systems and to ensure that their installation will occur prior to enclosing or concealing work.

C. Install all firestop systems after voids and joints are prepared sufficiently to accept the applicable firestop system.

D. Do not cover firestop systems until they have been properly inspected and accepted by the authority having jurisdiction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Hilti, Inc.
2. Metacaulk.
3. Nelson.
4. Specified Technologies Inc.
5. 3M.
6. Tremco.
7. U.S. Gypsum Co.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

B. Accessories: Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:

a. Semirefractory fiber (mineral wool) insulation.
b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.

c. Fire-rated form board.
d. Joint fillers for joint sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

D. Smokeseals at top of partitions shall be flexible to allow for partition deflection.

E. Polypropylene Sleeves (PP): (For cast-in device options.)

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Endothermic, Latex Compound Sealant: Single-component, endothermic, latex formulation.

B. Intumescent, Latex Sealant: Single-component, Intumescent, latex formulation.

C. Intumescent Putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.

D. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum or polyethylene foil on one side.

E. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.

F. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

G. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

H. Moldable putty pads by 3M or approved equal.

I. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.

J. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless firestop system limits use to non-sag grade for both opening conditions.

K. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic or polypropylene sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

L. Fire Rated Cable Management Devices: Factory-assembled round metallic sleeve device for use with cable penetrations, containing an integrated smoke seal fabric membrane that can be opened and closed for re-penetration.

M. Drop-In Firestop Devices: Factory-assembled devices for use with combustible or noncombustible penetrants in cored holes within concrete floors. Device shall consist of galvanized steel sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete floor, and neoprene gasket.

N. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

O. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

P. Blocks/Plugs: Intumescent flexible block/plug suitable for reuse in re-penetration of openings. Blocks shall allow up to 12" of unreinforced annular space.

Q. Tub Box Kit: Cast-in place pre-formed plastic tub box kit with three support legs for use with drain piping assembly associated with bathtub installations.

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

1. Sealant Colors: Color of exposed joint sealants as selected by the Architect.

B. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 33 percent movement in both extension and compression for a total of 66 percent movement.

C. Multi-Component, Non-Sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated.

D. Single-Component, Non-Sag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.5 MINERAL FIBER/CERAMIC WOOL NON-COMBUSTIBLE INSULATION (FIRE SAFING)

A. Provide min. 4 pcf safing insulation; Thermafiber Safing Mineral Wool Insulation by Thermafiber, Inc. (an Owens Corning company), Roxul Safe Fire Safing Insulation by Rockwool, Mineral Wool Safing by Johns Manville or approved equal to suit conditions and to comply with fire resistance and firestop manufacturer's requirements.

B. Material shall be classified non-combustible when tested per ASTM E 136.

2.6 MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping 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 configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping 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 firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 CONDITIONS REQUIRING FIRESTOPPING

A. Building Exterior Perimeters

1. Where exterior facing construction is continuous past a structural floor, and a space (i.e. construction joint) would otherwise remain open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide firestopping to equal the fire resistance of the floor assembly.

    a. If mineral wool is part of firestop system, the mineral wool must be completely covered by appropriate thickness of UL or Warnock Hersey listed firestop sealant or spray.
    b. Refer to Article 3.6 herein for description of fire safing insulation.

2. Firestopping shall be provided whether or not there are any clips, angles, plates, or other members bridging or interconnecting the facing and floor systems, and whether or not such items are continuous.

3. Where an exterior wall passes a perimeter structural member, such as a girder, beam, or spandrel, and the finish on the interior wall face does not continue up to close with the underside of the structural floor above, thus interrupting the fire-resistive integrity of the wall system, and a space would otherwise remain open between the interior face of the wall and the structural member, provide firestopping to continuously fill such open space.

B. Interior Walls and Partitions

1. Construction joints between top of fire rated walls and underside of floors above, shall be firestopped.

2. Firestop system installed shall have been tested by either UL or Omega Point, including exposure to hose stream test and including for use with steel fluted deck floor assemblies.

3. Firestop system used shall allow for deflection of floor above.

C. Penetrations

1. Penetrations include conduit, cable, wire, pipe, duct, or other elements which pass through one or both outer surfaces of a fire rated floor, wall, or partition.

2. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814.

3. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space, if any, between sleeve and wall of opening.

D. Provide firestopping to fill miscellaneous voids and openings in fire rated construction in a manner essentially the same as specified herein before.

3.4 INSTALLING THROUGH PENETRATION FIRESTOPS

A. General: Comply with the through penetrations firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

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 work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 INSTALLING FIRE RESISTIVE JOINT SEALANTS

A. General: Comply with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers 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 and develop fire resistance rating required.

C. 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 width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool no sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.6 INSTALLING FIRESAFING INSULATION

A. Install fire safing insulation utilizing welded or screw applied galvanized steel impaling pins and retaining clips; space clips or pins 24" o.c. maximum.

B. Completely fill voids in areas where safing insulation is required. At spandrel conditions/floor edges, depth of insulation top to bottom shall be at least four (4) inches.

C. Cover top of all safing insulation with firestop sealant or spray.

3.7 FIELD QUALITY CONTROL

A. Inspecting agency employed and paid by the Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.

B. Inspecting agency will report observations promptly and in writing to Contractor, Owner and Architect.

C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

D. Where deficiencies are found, Contractor must repair or replace firestopping so that it complies with requirements.

3.8 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which openings and joints occur.

B. Protect firestopping 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 firestopping immediately and install new materials to product firestopping complying with specified requirements.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the joint sealant work as indicated on the drawings and/or specified herein, including the following:

1. Flashing reglets and retainers.
2. Coping joints.
3. Exterior wall joints not specified to be sealed in other Sections of work.
4. Interior wall joints not specified to be sealed in other Sections of work, including caulking to fill between architectural woodwork and any wall, floor and/or ceiling imperfections.
5. Control and expansion joints in walls.
6. Preformed foam joint sealant.
7. Joints at wall penetrations.
8. Joints between items of equipment and other construction.
9. All other joints required to be sealed to provide a positive barrier against penetration of air and moisture.

1.3 RELATED SECTIONS

A. Exterior Stone Cladding - Section 044200.

B. Cast Stone - Section 047200.

C. Roofing - Division 7.

D. Firestop sealants - Section 078413.

E. Glazing sealants - Section 088000.

F. Sealant within drywall construction - Section 092900.

G. Sealant at tile work - Section 093013.

H. Sealant at paving - Division 32.

1.4 QUALITY ASSURANCE

A. Qualification of Installers: Use only personnel who are thoroughly familiar, skilled and specially trained in the techniques of sealant work, and who are completely familiar with the published recommendations of the sealant manufacturer.

B. Pre-Construction Field Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to project joint substrates according to the method in ASTM C 794 and C 1521 that is appropriate for the types of Project joints.

C. Perform testing per ASTM C 1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work shall start until results of these tests have been submitted and the Architect has given written approval to proceed with the work.

1.5 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing all joint conditions, indicating relation of adjacent materials, all sealant materials (sealant, bond breakers, backing, primers, etc.), and method of installation.

1. Submit joint sizing calculations certifying that movement capability of sealant is not being exceeded.

B. Samples: Submit the following:

1. Color samples of sealants, submit physical samples (not color chart).

2. Sealant bond breaker and joint backing.

C. Product Data: Submit manufacturer's technical information and installation instructions for:

1. Sealant materials, indicating that material meets standards specified herein.

2. Backing rods.

D. Submit manufacturer's certification as required by Article 1.6 herein.

E. Submit results of testing required in Article 1.4 herein.

1.6 MANUFACTURER'S RESPONSIBILITY AND CERTIFICATION

A. Contractor shall require sealant manufacturer to review the Project joint conditions and details for this Section of the work. Contractor shall submit to the Architect written certification from the sealant manufacturer that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vapor-tight seals (as applicable), and that materials supplied meet specified performance requirements.

1.7 ENVIRONMENTAL CONDITIONS

A. Temperature: Install all work of this Section when air temperature is above forty (40) degrees F. and below eighty (80) degrees F., unless manufacturer submits written instructions permitting sealant use outside of this temperature range.

B. Moisture: Do not apply work of this Section on surfaces which are wet, damp, or have frost.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section, before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

C. Storage

1. Store sealant materials and equipment under conditions recommended by their manufacturer.

2. Do not use materials stored for a period of time exceeding the maximum recommended shelf life of the material.

3. Material shall be stored in unopened containers with manufacturers' name, batch number and date when shelf life expires.

1.9 WARRANTY

A. Provide a written, notarized warranty from the manufacturer stating that the applied sealants shall show no material failure for a period of twenty (20) years.

B. Contractor to provide a written, notarized warranty stating that the applied sealants shall show no failure due to improper installation for a period of five (5) years.

C. Warranty shall be in a form acceptable to the Owner and executed by an authorized individual.

D. Include in warranty an agreement to repair and/or replace, at the Contractor's expense, sealant defects that develop during the warranty period as a result of faulty labor and/or materials.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Exterior Wall Sealant: Provide one (1) part non-sag sealant equal to "DOWSIL 790" or "DOWSIL 795" made by The Dow Chemical Company, "Silpruf SCS 2000" or "LM SCS 2700" made by G.E., "Spectrem 1" or "Spectrem 3" made by Tremco or "Sonolastic 150" by Sonneborn conforming to the minimum standards of ASTM C 920, Type S, Grade NS, Class 50.

B. Interior Sealant: Provide a one (1) part acrylic-based sealant conforming to ASTM C 834, equal to "AC-20+ Silicone" made by Pecora, Masterseal NP 520 by BASF or equal made by Tremco.

C. Colors: Colors selected from manufacturer's standard selection.

D. Preformed Foam Sealant: Manufacturer's standard preformed, precompressed, open-cell polyurethane foam sealant impregnated with a water-based, non-drying polymer-modified acrylic water repellent.

1. Provide "Seismic Compression Seal" as manufactured by Nystrom, or comparable product by Emseal Joint Systems, Ltd., InPro, or approved equal.

2. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants. Density: 8.4 to 9.1 lb./cu. ft.

2.2 MISCELLANEOUS MATERIALS

A. Back-Up Materials: Provide back-up materials and preformed joint fillers, non-staining, non-absorbent, compatible with sealant and primer, and of a resilient nature, equal to "HBR" made by Nomaco Inc. or approved equal, twenty-five (25) percent wider than joint width. Materials impregnated with oil, bitumen or similar materials shall not be used. Provide back-up materials only as recommended by sealant manufacturer in writing.

B. Provide bond breakers, where required, of polyethylene tape as recommended by manufacturer of sealant.

C. Provide primers recommended by the sealant manufacturer for each material to receive sealant. Note that each exterior joint must be primed prior to sealing.

D. Provide solvent, cleaning agents and other accessory materials as recommended by the sealant manufacturer.

E. Materials shall be delivered to the job in sealed containers with manufacturer's original labels attached. Materials shall be used per manufacturer's printed instructions.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where joint sealants are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with instructions and recommendations of the manufacturer and in accordance with ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions required by this Project where more stringent installation requirements are specified herein, such requirements shall apply.

B. Sample Section of Sealant

1. During sealant installation work in exterior wall, the manufacturer of sealant shall send their representative to the site, under whose supervision a section of the wall (used as "control section") shall be completed for purposes of determining performance characteristics of sealant in joints. Architect shall be informed of time and place of such installation of control section.

2. Control section shall be installed according to specification given herein and shall not be considered as acceptable until written acceptance is provided by the Architect.

3. Accepted control section shall be standard to which all other sealant work must conform.

C. Supervision: The Contractor shall submit to the Architect written certification from the sealant manufacturer that the applicators have been instructed in the proper application of their

materials. The Contractor shall use only skilled and experienced workmen for installation of sealant.

D. Apply sealant under pressure with a hand or power actuated gun or other appropriate means. Gun shall have nozzle of proper size and provide sufficient pressure to completely fill joints as detailed. Neatly point or tool joint to provide the contour as indicated on the drawings.

E. Preparation and Application

1. Thoroughly clean all joints, removing all foreign matter such as dust, oil, grease, water, surface dirt and frost. Sealant must be applied to the base surface. Previously applied film must be entirely removed.

2. Stone, masonry and concrete surfaces to receive sealant shall be cleaned where necessary by grinding, water blast cleaning, mechanical abrading, or combination of these methods as required to provide a clean, sound base surface for sealant adhesion.

   a. Do not use any acid or other material which might stain surfaces.
   b. Remove laitance by grinding or mechanical abrading.
   c. Remove loose particles present or resulting from grinding, abrading, or blast cleaning by blowing out joints with compressed air, oil and water free, or vacuuming joints prior to application of primer or sealant.

3. Clean non-porous surfaces such as metal and glass chemically. Remove protective coatings on metallic surfaces by solvent that leaves no residue and is compatible with sealant. Use solvent and wipe dry with clean, dry lint free paper towels. Do not allow solvent to air dry without wiping. Clean joint areas protected with masking tape or strippable films as above after removal of tape film.

4. Do not seal joints until they are in compliance with drawings, or meet with the control section standard.

5. Joint Size and Sealant Size: Joints to receive sealant shall be at least 1/4" wide. In joint 1/4" to 3/8" wide, sealant shall be 1/4" deep. In joints wider than 3/8" and up to 1" wide, sealant depth shall be one half the joint width. For joints wider than 1", sealant depth shall be as recommended by the sealant manufacturer. Depth of joint is defined as distance from outside face of joint to closest point of the filler.

6. Primer: Thoroughly clean joints and apply primer to all surfaces that will receive sealant. Apply primer on clean, dry surfaces, and prior to installation of joint backing. Completely wet both inner faces of the joint with primer. Mask adjacent surfaces of joint with non-staining masking tape prior to priming. Apply primer with clean brush and only when temperature is above 45 deg. F.

7. Joint Backing: In joints where depth of joint exceeds required depth of sealant, install joint backing (after primer is dry) in joints to provide backing and proper joint shape for sealant. Proper shape for sealant is a very slight "hourglass" shape, with back and front face having slight concave curvature. Use special blunt T-shaped tool or roller to install joint backing to the proper and uniform depth required for the sealant. Joint backing shall be installed with approximately twenty-five (25) percent compressions. Do not stretch, twist, braid, puncture, or tear joint backing. Butt joint backing at intersections.

8. Bond Breaker: Install bond breaker smoothly over joint backing so that sealant adheres only to the sides of the joint and not backing.

9. Sealant Application: Apply sealant in accordance with the manufacturer's application manual and manufacturer's instructions, using hand guns or pressure equipment, on clean, dry, properly prepared substrates, completely filling joints to eliminate air pockets and voids. Mask adjacent surfaces of joint with non-staining masking tape. Force sealant into joint in front of the tip of the "caulking gun" (not pulled after it) and force sealant against sides to make uniform contact with sides of joint and to prevent entrapped air or pulling of sealant off of sides. Fill sealant space solid with sealant.

10. Tooling: Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C 1193. Finished joints shall be straight, uniform, smooth and neatly finished. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Neatly remove any excess sealant from adjacent surfaces of joint, leaving the work in a neat, clean condition.

11. Replace sealant which is damaged during construction process.

F. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer’s written instructions.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 5,000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION

SECTION 081113 - STEEL DOORS AND FRAMES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the steel door and frame work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Interior and exterior hollow metal doors and frames for fire-rated and unrated door openings.
2. Security hollow metal doors and frames.
3. Interior hollow metal vision panels.
4. Preparation of metal doors and frames to receive finish hardware, including reinforcements, drilling, and tapping, as necessary.
5. Preparation of hollow metal doors to receive glazing where required.
6. Furnishing anchors for building into masonry and drywall.
7. Factory prime painting of work of this Section.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Carpentry - Section 062000, for installation of doors and frames.

C. Finish Hardware - Section 087100.

D. Glass and Glazing - Section 088000.

E. Gypsum Drywall - Section 092900.

F. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing custom steel doors and frames 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. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain custom steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40" or less above the sill.

2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.

3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating as required by prevailing Building Code in 30 minutes of fire exposure.

4. Fire rated assemblies must have UL approved label.

E. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

F. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, compliance with standards referenced herein, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Show fabrication and installation of doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, reinforcement for surface applied hardware, dimensions of profiles and hardware preparation, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessories.

C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Drawings.

1. Coordinate glazing frames and stops with glass and glazing requirements.

D. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage. Do not use nonvented plastic.

B. Inspect doors and frames, on delivery, for damage. Minor damage may be repaired provided refinished items match new work and are approved by Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames under cover at building site. Conform to the requirements of ANSI A 250-11-2001 for site storage unless more stringent requirements are noted herein. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.1 FABRICATION - GENERAL

A. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

B. Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

C. Prepare hollow metal units to receive finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with Finish Hardware Schedule and templates provided by hardware suppliers. Comply with applicable requirements of ANSI A115 "Specifications for Door and Frame Preparation for Hardware."

D. Locate finish hardware as shown on final shop drawings in accordance with locations noted herein.

2.2 MANUFACTURERS

A. Provide products manufactured by Steelcraft, Curries, Ceco Door Products, or approved equal meeting these specifications.

B. Exterior Doors and Frames

1. Basis of Design (Doors): "777E - Trio-E" energy efficient doors by Curries, or approved equal.

2. Basis of Design (Frames): Curries Company (CU) – Mercury Thermal Broken Frames by Curries or approved equal.

2.3 FRAMES

A. Materials

1. Frames for exterior openings shall be made of commercial grade cold-rolled steel conforming to ASTM A 1008, Type B not less than 14 ga., and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653 with A60 coating. The zinc-alloy coating shall be a dull matte surface treated for paint adhesion.

2. Frames for interior openings shall be either commercial grade cold-rolled steel conforming to ASTM A 1008, Type B or commercial grade hot-rolled steel conforming to ASTM A 1011, Commercial Steel, Type B. Metal thickness shall be not less than sixteen (16) ga. for frames in openings 4'-0" or less in width; not less than fourteen (14) ga. for frames in openings over 4'-0" in width.

B. Design and Construction

1. All frames shall be welded units with integral trim, of the sizes and shapes shown on approved shop drawings. Knock-down frames are not permitted.

2. Thermal-Break Frames: Frames shall be subject to the same compliance standards and requirements as standard hollow metal frames. Frames shall be tested for thermal performance in accordance with NFRC 102 and resistance to air infiltration in accordance with NFRC 400. Where indicated, provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weather stripping.

3. All finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp, or buckle. Molded members shall be clean cut, straight and of uniform profile throughout their lengths.

4. Jamb depths, trim, profile, and backbends shall be as shown on drawings.

   a. Frames at drywall partitions shall be formed with double return backbends to prevent cutting into drywall surface.

5. Welded frames shall have corners mitered and reinforced and faces of welded frames shall be continuously back welded full depth and width of frame conforming to NAAMM Standard HMMA-820; face joints shall be hairline.

6. Minimum depth of stops shall be 5/8".

7. Frames for multiple or special openings shall have mullion and/or rail members which are closed tubular shapes having no visible seams or joints. All joints between faces of abutting members shall be securely welded and finished smooth.

   a. Mullions shall have 16 ga. internal steel stiffeners welded not less than 4" o.c.

8. Hardware Reinforcements

   a. Frames shall be mortised, reinforced, drilled and tapped at the factory for fully-templated, mortised hardware only, in accordance with approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates.
   b. Minimum thickness of hardware reinforcing plates shall be as follows (Contractor shall provide larger and thicker plates as required to accommodate weight of door):
      1). Hinge and pivot reinforcements - seven (7) ga., 1-1/4" x 10" minimum size.
      2). Strike reinforcements - twelve (12) gauge.
      3). Flush bolt reinforcements - twelve (12) gauge.
      4). Closer reinforcements - twelve (12) gauge.
      5). Reinforcements for surface mounted hardware - twelve (12) gauge.

9. Floor Anchors

    a. Provide adjustable floor anchors, providing not less than two (2) inch height adjustment.
    b. Minimum thickness of floor anchors shall be fourteen (14) gauge.

10. Jamb Anchors

    a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the wire type. Anchors shall be not less than 0.156" diameter steel wire. The number of anchors provided on each jamb shall be as follows:
        1). Frames up to 7'-6" height - three (3) anchors.
        2). Frames 7'-6" to 8'-0" height - four (4) anchors.
        3). Frames over 8'-0" height - one (1) anchor for each 2'-0" or fraction thereof in height.
    b. Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than eighteen (18) gauge thickness, securely welded inside each jamb as follows:
        1). Frames up to 7'-6" height - four (4) anchors.
        2). Frames 7'-6" to 8'-0" height - five (5) anchors.
        3). Frames over 8'-0" height - five (5) anchors plus one additional for each 2'-0" or fraction thereof over 8'-0".

11. Anchors in exterior frames and in masonry walls shall be hot dip galvanized per ASTM A 153.

12. Frames for installation in masonry wall openings more than 4'-0" in width shall have an angle or channel stiffener factory welded into the head. Such stiffeners shall be not less than twelve (12) gauge steel and not longer than the opening width. Stiffeners shall not be used as lintels or load bearing members.

13. Dust cover boxes (or mortar guards) of not thinner than twenty-six (26) gauge steel shall be provided at all hardware mortises on frames to be set in masonry or plaster partitions.

14. Ceiling Struts: Minimum 3/8" thick x 2" wide steel.

15. All frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

16. Loose glazing stops shall be of cold rolled steel, not less than twenty (20) gauge thickness, butted at corner joints and secured to the frame with countersunk cadmium-or zinc-plated screws. Interior frames may be provided with snap-on glazing stops.

17. Except on weatherstripped frames, drill stops to receive three (3) silencers on strike jambs of single door frames and two (2) silencers on heads of double-door frames.

C. Finish: After fabrication, all tool marks and surface imperfections shall be removed, and exposed faces of all welded joints shall be dressed smooth. Frames shall then be chemically treated to insure maximum paint adhesion and shall be coated on all surfaces with one coat of rust-inhibitive baked-on alkyd primer standard with the manufacturer which is fully cured before shipment to a dry film thickness of 2.0 mils.

1. Frames set in masonry walls shall be grouted in as described in Section 042000, "Unit Masonry." These frames shall have surfaces in contact with grout shop coated with epoxy coating equal to Series 27 FC Typoxy made by Tnemec or approved equal spray applied at 4 to 6 mils, passing NFPA 101, Class A for smoke and flame spread, tested per ASTM E 84.

2.4 HOLLOW METAL DOORS

A. Materials: Doors shall be made of commercial quality, level, cold rolled steel conforming to ASTM A 1008, Commercial Steel, Type B and free of scale, pitting or other surface defects. Face sheets for interior doors shall be not less than eighteen (18) gauge. Face sheets for exterior doors shall be not less than sixteen (16) gauge and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653, A60 coating. The zinc alloy coating shall be a dull matte surface treated for paint adhesion.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level.

1. Design: Flush panel.

2. Core Construction: Foamed-in-place polyurethane and steel-reinforced core with no stiffener face welds.

   a. Provide 16 gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed-in-place polyurethane core shall be chemically bonded to all interior surfaces. No face welding is permitted.
   b. Thermal properties to rate at a fully operable minimum U-Factor 0.374 and R-Value 2.53, including insulated door, Mercury thermal-break frame and threshold.
   c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.378 and R-Value 2.5, including insulated door, kerf type frame, and threshold.

C. Design and Construction

1. All doors shall be of the types and sizes shown on the approved shop drawings and shall be fully-welded, seamless construction with no visible seams or joints on their faces or vertical edges. Minimum door thickness shall be 1-3/4".

2. All doors shall be strong, rigid, and neat in appearance, free from warpage or buckles. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

3. Face sheets shall be stiffened by continuous vertical formed steel sections spanning the full thickness of the interior space between door faces. These stiffeners shall be not less than twenty-two (22) gauge spaced not more than six (6) inches apart and securely attached to face sheets by spot welds not more than five (5) inches o.c. Spaces between stiffeners shall be sound deadened and thermal insulated the full height of the door with an inorganic non-combustible batt type material.

4. Door faces shall be joined at their vertical edges by a continuous weld extending the full height of the door. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface.

5. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than fourteen (14) gauge, extending the full width of the door and spot welded to both faces. Exterior doors shall have an additional flush closing channel at their top edges and, where required for attachment of weatherstripping, a flush closure also at their bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.

6. Edge profiles shall be provided on both vertical edges of doors as follows:

   a. Single-Acting Swing Doors: Beveled 1/8" in two (2) inches.
   b. Double-Acting Swing Doors: Rounded on 2-1/8" radius.
   c. No square edge doors permitted.

7. Hardware Reinforcements

   a. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware only in accord with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware (or hardware, the interrelation of which is to be adjusted upon installation - such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates.
   b. Minimum gauges for hardware reinforcing plates shall be as follows (Contractor shall provide larger and thicker plates as required to accommodate weight of door):
      1). Hinge and pivot reinforcement - seven (7) gauge.
      2). Reinforcement for lock face, flush bolts, concealed holders, concealed or surface mounted closers - twelve (12) gauge.
      3). Reinforcements for all other surface mounted hardware - sixteen (16) gauge.

8. Glass Moldings and Stops

   a. Where specified or scheduled, doors shall be provided with hollow metal moldings to secure glazing by others in accordance with glass opening sizes shown on drawings.
   b. Fixed moldings shall be securely welded to the door on the security side.
   c. Loose stops shall be not less than twenty (20) gauge steel, with mitered corner joints, secured to the framed opening by cadmium or zinc-coated countersunk screws spaced eight (8) inches o.c. Snap-on attachments will not be permitted. Stops shall be flush with face of door.

D. Finish: After fabrication, all tool marks and surface imperfections shall be dressed, filled and sanded as required to make all faces and vertical edges smooth, level and free of all irregularities. Doors shall then be chemically treated to insure maximum paint adhesion and shall be coated, on all exposed surfaces, with manufacturer's standard rust-inhibitive alkyd primer as specified for frames which shall be fully cured before shipment.

E. Flatness: Doors shall maintain a flatness tolerance of 1/16" maximum, in any direction, including in a diagonal direction.

2.5 LABELED DOORS AND FRAMES

A. Labeled doors and frames shall be provided for those openings requiring fire protection ratings as scheduled on drawings. Such doors and frames shall be labeled by Underwriters' Laboratories or other nationally recognized agency having a factory inspection service.

B. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, size, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.

2.6 SECURUTY HOLLOW-METAL DOORS AND FRAMES

A. Ballistic Rated Doors: Provide "Armorshield" as manufactured by Ceco, or approved equal, meeting UL 752 Level 5 bullet protection.

1. Door and frame modules shall be constructed of ballistic-resistant steel, minimum 12 gauge. Steel shall be free of scale, pitting, coil breaks, or other surface defects.

2. Core Construction

a. Provide thermal-resistance-rated cores for exterior doors.
b. Steel-Stiffened Core: 0.026-inch thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6" apart, spot welded to face sheets a maximum of 5" o.c. Spaces filled between stiffeners with glass- or mineral-fiber insulation.
1). Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
2). Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x hx sq. ft./Btu when tested according to ASTM C 1363.

3. Transparent armor glazing materials shall be fabricated of fully-laminated chemically strengthened or annealed glass, and PVB interlayers. The glass shall meet or exceed ANSI Z-97.1-1975 break safe characteristic, ASTM C 158 modulus of rupture test, and Federal specification numbers DD-G-1403B for thickness, warpage, and quality tolerances, and DD-G-451D for thickness, cutting, and quality standards.

B. Security Hollow Metal Frames, General: Fabricate frames of construction indicated. Close contact edges of corner joints tight with faces mitered and stops butted or mitered. Continuously weld faces and soffits and finish faces smooth. Comply with ANSI/NAAMM-HMMA 861.

1. Door Frames for Security Doors: Fabricated from 1/8" thick steel sheet.

2. Exterior Frames: Formed from metallic-coated steel sheet.

3. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.

4. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 861 with reinforcing plates from same material as frame.

5. Head Reinforcement: Provide minimum 0.093" thick, steel channel or angle stiffener for opening widths more than 48".

2.7 HARDWARE LOCATIONS

A. The location of hardware on doors and frames shall be as noted in "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" of the Door Hardware Institute unless otherwise required by prevailing Handicapped Codes.

2.8 CLEARANCES

A. Fabricate doors and frames to meet edge clearances as follows:

1. Jambs and Head: 1/8" plus or minus 1/16".

2. Meeting Edges, Pairs of Doors: 1/8" plus or minus 1/16".

3. Bottom: 3/8" at threshold; 3/4" if no threshold.

B. Fire-rated doors shall have clearances as required by NFPA 80.

2.9 MANUFACTURING TOLERANCES

A. Manufacturing tolerance shall be maintained within the limits given in HMMA 841 of ANSI/NAAMM, current edition.

2.10 PREPARATION FOR FINISH HARDWARE

A. Prepare door and frames to receive hardware:

1. Hardware supplier shall furnish hollow metal manufacturer approved hardware schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.

2. Preparation includes sinkages and cut-outs for mortise and concealed hardware.

B. Provide reinforcements for both concealed and surface applied hardware:

1. Drill and tap mortise reinforcements at factory, using templates.

2. Install reinforcements with concealed connections designed to develop full strength of reinforcements.

2.11 REJECTION

A. Hollow metal frames or doors which are defective, have hardware cutouts of improper size or location, or which prevent proper installation of doors, hardware, or work of other trades, shall be removed and replaced with new at no cost.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel doors and frames are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Refer to Section 062000 for installation procedures for all work of this Section.

END OF SECTION

SECTION 083113 - ACCESS DOORS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the access doors as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Stainless steel frameless recessed panel access doors at walls.

2. Framed flush panel access doors at masonry and tile walls.

3. GFRG access doors for drywall ceilings.

4. Provide access doors and frames for access from occupied spaces to the following, where indicated or required, and as directed by the trades of Divisions 23 and 26.

    a. All shutoff or balancing valves.
    b. Fire dampers, as required.
    c. Points of duct access.
    d. Pull boxes.
    e. Controls of mechanical and electrical items.
    f. Masonry shafts for pipes and conduits, as required.
    g. Pipe spaces, if required.
    h. Inlets of fans.
    i. Fusible link and splitter damper at filter bank.
    j. Automatic damper and motor.
    k. Equipment not otherwise accessible.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Gypsum Drywall - Section 092900.

C. Ceramic Tiling - Section 093013.

D. Valves and connections - Division 23.

1.4 QUALITY ASSURANCE

A. For actual installation of the work of this Section, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the skills required.

B. Fire-Resistance Ratings: Wherever a fire-resistance classification is shown, or for construction where access doors are installed, provide required access door assembly with panel door, frame, hinge and latch from manufacturers listed in Underwriters' Laboratories, Inc. "Classified Building Materials Index" for the rating shown.

1. Provide UL label on each access panel.

2. Provide flush, key operated cylinder lock.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes shown or scheduled.

1.5 SUBMITTALS

A. Before any materials of this Section are delivered to the job site, submit complete manufacturer's literature to the Architect. Submit plans and schedules showing size and location of each and every access door for Architect's acceptance prior to installation.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 METAL ACCESS DOORS

A. Provide access door assembly manufactured by Cendrex, or comparable product by Karp Associates, Inc., Milcor Inc., Nystrom Inc., or approved equal. Assembly shall be an integral unit complete with all parts and ready for installation.

B. Fabricate units of continuous welded steel construction. Grind welds smooth and flush with adjacent surfaces. Provide attachment devices and fasteners of the type required to secure access panels to the types of supports shown.

C. Frames for Masonry and Tile Wall Only (Flush Panel Units): Fabricate frame from sixteen (16) gauge steel. Provide frame with exposed flange not less than one (1) inch wide around perimeter of frame for the exposed masonry and tile finishes.

1. For installation in masonry construction, provide frames with adjustable metal masonry anchors.

D. Stainless Steel Frameless Units for Drywall Surfaces (Recessed Panel Units): Provide access doors without exposed frames for drywall adhered to recessed panel.

E. Panels: Fabricate from fourteen (14) gauge steel or stainless steel at drywall panels, with concealed spring hinges set to open to 175 degrees. Provide removable pin type hinges of the quantity required to support the access panel sizes used in the work. Finish with manufacturer's factory applied baked enamel prime coat applied over phosphate protective coating on steel.

F. Locking Devices

1. For non-rated access doors, provide flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.

2. For fire rated doors, provide locks as described in paragraph 1.4, B. herein.

G. Inserts and Anchorage: Furnish inserts and anchoring devices which must be built into masonry for the installation of access panels. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

2.2 GFRG ACCESS DOORS

A. Provide glass-fiber-reinforced gypsum (GFRG) access panels with concealed frames, shell thickness of 1/8" to 3/16", equal to ceiling "Stealth" access panels by Wind-Lock or equal made by Intax Forms Inc., Stylemark, or approved equal; size as scheduled.

B. Finishing: Same as adjacent drywall.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where access doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 COORDINATION

A. Coordinate all work with the mechanical trades to insure proper locations and in a timely manner to permit orderly progress of the total work.

B. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

D. Remove and replace panels or frames which are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the overhead coiling doors as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Insulated overhead coiling doors, rated and unrated.
2. Hardware and accessories.
3. Motor operation.

1.3 RELATED SECTIONS

A. Door Hardware - Section 087100.

B. Painting and Finishing - Section 099000.

C. Electrical - Division 26.

1.4 QUALITY ASSURANCE

A. Furnish each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.

B. Provide each type of overhead coiling door by one manufacturer for entire project.

C. Wind Loading: Design and reinforce exterior overhead coiling doors to withstand a thirty (30) lb. per square foot wind loading pressure, unless otherwise indicated.

D. Rated Overhead Coiling Door Assemblies

1. Furnish overhead coiling door assemblies where scheduled on drawings which comply with NFPA No. 80 and have been fire tested, rated and labeled in accordance with ANSI/ASTM E 152. Furnish each shutter with a metal UL label as evidence of rating, with label indicating rating in hours of duration of exposure to fire and letter designation of location for which assembly is designed.

2. Provide automatic closing device and governor, operating when activated by temperature rise and melting of one hundred sixty (160) degrees F. (71 deg. C.) fusible link and smoke detector. Construct governor unit to be inoperative during normal shutter operations. Design release mechanism for easy resetting.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead coiling door. Include operating instructions and maintenance information.

B. Shop Drawings: Submit shop drawings for special components and installations which are not fully dimensioned or detailed on manufacturer's data sheets.

C. Label Certification: Submit UL certification for fire-rated doors and frames.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide overhead coiling doors manufactured by Cornell Iron Works Inc., Atlas, Overhead Door Corp., or approved equal meeting these specifications.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Shutter Curtain: Fabricate overhead coiling door curtains of interlocking flat slats designed to withstand required wind loading, of continuous length for width of doors, without splices. Provide slats of structural quality, minimum twenty (20) gauge cold-rolled galvanized steel sheets complying with ASTM A 924, Grade A, with G90 zinc coating, complying with ASTM A 653, and phosphate treated before fabrication.

1. Curtain shall be insulated with 1" urethane and 22 ga. back-up sheet.

B. Endlocks: Malleable iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Windlocks: Malleable iron castings secured to curtain slats with galvanized rivets. Provide windlocks on roll-up doors approximately twenty-four (24) inches o.c. on both edges of curtain.

D. Bottom Bar: Consisting of two (2) angles, each not less than 1-1/2" x 1-1/2" x 1/8" thick, either galvanized or stainless steel or aluminum extrusions to suit type of curtain slats.

E. Curtain Jamb Guides: Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build up units with minimum 3/16" thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

1. Secure continuous wall angle to wall framing by 3/8" minimum bolts at not more than twenty-four (24) inches o.c. Extend wall angles above overhead coiling door opening head to support coil brackets, unless otherwise shown. Place anchor bolts on exterior wall guides so they are concealed when overhead coiling door is in closed position. Provide

removable stops on guides to prevent over-travel of curtain, and continuous bar for holding windlocks.

F. Weather Seals: Provide vinyl or neoprene weatherstripping for exterior doors. At door heads, use 1/8" thick continuous sheet secured to inside of curtain coil hood. At door jambs, use 1/8" thick continuous strip secured to exterior side of jamb guide.

2.3 COUNTERBALANCING MECHANISM

A. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and mounted in a spring barrel and connected to door curtain with required barrel rings. Use grease sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support curtain without distortion of slats and limit barrel deflection to not more than 0.03" per foot of span under full load.

C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

D. Fabricate torsion rod for counterbalance shaft of cast-hardened steel, of required size to hold fixed springs ends and carry torsion load.

E. Brackets: Provide mounting brackets of manufacturer's standards design, either cast iron or cold-rolled steel plate with bell mouth guide groove for curtain.

F. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head, and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

1. Fabricate steel hoods for doors of not less than twenty (20) gauge hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 525. Phosphate treat before fabrication.

2. At fire rated assemblies furnish automatic drop baffle to guard against passage of smoke or flame.

2.4 INSERTS AND ANCHORAGES

A. Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of units. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

B. Refer to concrete and masonry Sections of these specifications for installation of inserts and anchorage devices.

2.5 PAINTING

A. Shop clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except faying and lubricated surfaces, with door manufacturer's standard rust inhibitive primer.

2.6 ELECTRIC DOOR OPERATORS

A. Furnish electric door operator assembly of size and capacity recommended and provided by door manufacturer; complete with electric motor and factory pre-wired motor controls, gear reduction unit, solenoid operated brake, remote control stations, control devices, conduit and wiring from controls to motor and control stations, and accessories required for proper operation.

B. Provide hand operated disconnect or a mechanism for automatically engaging a sprocket and chain operator and releasing brake for emergency manual operation. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

C. Design operator so that motor may be removed without disturbing limit switch adjustment and without affecting emergency auxiliary operator.

D. Door Operator Type: Provide wall or bracket mounted door operator units consisting of electric motor, worm gear drive from motor to reduction gear box, chain or worm gear drive from reduction box to gear wheel mounted on counterbalance shaft, and a disconnect-release for manual operation. Provide motor and drive assembly of horsepower and design as determined by door manufacturer for size of door required.

E. Electric Motors: Provide high starting torque, reversible, constant duty, Class A insulated electric motors with overload protection, sized to move overhead coiling door in either direction, from any position, at not less than 2/3 foot nor more than one (1) foot per second.

   1. Coordinate wiring requirements and current characteristics of motors with building electrical system.

   2. Furnish totally enclosed, non-ventilated type motors, fitted with plugged drain, and controller with NEMA Type 4 enclosure.

F. Remote Control Station: Provide momentary contact, 3-button control station with push button controls labeled "open," "close," and "stop."

   1. Provide interior units, full-guarded, surface mounted, heavy duty, with NEMA Type 4 enclosure.

G. Automatic Reversing Control: Furnish each door with automatic safety switch, extending full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail. Contact with switch before fully closing will immediately stop downward travel and reverse direction to fully opened position. Connect to control circuit through retracting safety cord and reel, or self-coiling cable.

   1. Provide electrically actuated automatic bottom bar.

H. Locking Device: Curtain shall have cylinder locking device, including cylinder and 2 deadbolts, one at each end. Provide electric interlocks that prevent motor from operating when lock is engaged.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where overhead coiling doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install overhead coiling door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.

1. Install fire-rated doors to comply with NFPA 80.

B. Upon completion of installation, including work by other trades, lubricate, test and adjust overhead coiling doors to operate easily, free from warp, twist or distortion and fitting weather-tight for entire perimeter.

END OF SECTION

SECTION 084113 - ALUMINUM ENTRANCES AND STOREFRONTS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the aluminum entrances and storefronts as indicated on the drawings and/or specified herein, including the following:

1. Exterior entrance systems.
2. Interior entrance systems.
3. Exterior storefront systems.
4. Interior storefront systems.

1.3 RELATED SECTIONS

A. Joint Sealants - Section 079200.

B. Aluminum Windows - Section 085113.

C. Finish Hardware - Section 087100.

D. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Source: For each material type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Installer: A firm with a minimum of three years' experience in type of work required by this Section and which is acceptable to manufacturers of primary materials.

C. Design Criteria: Drawings indicate sizes, member spacings, profiles, and dimensional requirements of work of this Section. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Architect's sole judgment, such deviations do not materially detract from the design concept or intended performances.

D. Engineering: Provide services of a Professional Engineer registered in the State of New York to design and certify that work of this Section meets or exceeds performance requirements specified.

1.5 TESTS AND PERFORMANCE REQUIREMENTS

A. Manufacturer's Standard Tests: Provide manufacturer's standard test data showing compliance with specified requirements.

B. Testing and performance data apply to exterior assemblies.

C. Test Sequence: Test sequence is optional, except that air infiltration tests shall precede water resistance tests.

D. Air Infiltration Test: Test unit in accordance with ASTM E 283, as follows:

1. Static Air Pressure Difference: 6.24 psf for fixed storefront units, and 1.567 psf for doors.

2. Performance: Maximum air leakage shall not exceed Code requirements.

E. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.

1. Test Pressure: 6.24 psf.

2. Performance: No leakage as defined in test method at specified test pressure.

F. Uniform Load Deflection Test: Test units in accordance with ASTM E 330, at following static air pressure difference (Design Wind Pressure), or loads prescribed by code for this project site, whichever is greater. Apply pressure first to exterior side (positive) and then interior side (negative).

1. Design Wind Pressure: ASCE-7 or Building Code, whichever is more restrictive.

2. Test Procedure: Procedure A as specified in ASTM E 330.

3. Performance: Deflection in each member measured at locations of greatest deflection shall not exceed L/175 at specified Design Wind Pressure.

G. Uniform Load Structural Test: Test units in accordance with ASTM E 330 at following static air pressure difference. Apply high pressure load first on one side and then on other side. At conclusion of test there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms.

1. Static Air Pressure: Minimum 1.5 times the Design Wind Pressure.

2. Permanent Deformation in Any Member: Not to exceed 0.2% of member span.

H. Condensation Resistant Factor: See drawings.

I. Thermal Movement: Provide storefront systems that allow for expansion and contraction of members throughout an ambient temperature range of 120 degrees F.

J. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever are more stringent.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others. Show interfaces and relationships to work of other trades.

C. Field Measurements: Take necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

D. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

E. Verification Samples: Submit representative samples of each material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide samples having minimum size of 144 sq. in.

F. Calculations: Provide professionally prepared calculations and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied; refer to Article 1.4, para. D for further description.

G. Test Reports: Provide certified test reports for specified tests.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 WARRANTIES

A. Provide written warranty, signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship. "Defects" is defined to include, but not be limited to, leakage of water, abnormal aging or deterioration, abnormal deterioration or fading of finishes, and failure to perform as required. Include requirement for removal and replacement of covering and connected adjacent work.

1. Warranty Period: Three (3) years from date of Substantial Completion; except finish shall be warranted for a period of fifteen (15) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Provide storefronts and entrance systems of one of the following manufacturers that meet or exceed requirements of these specifications:

1. Oldcastle Building Envelope (basis of design).

2. Kawneer North America.

3. Tubelite, Inc.

4. YKK AP America, Inc.

B. Products:

1. Exterior frame system shall be equal to "Series 6000 Thermal MultiPane" manufactured by Oldcastle Building Envelope, or approved equal by one of the manufacturers listed above, glass set to the [front, center], thermally broken, [exterior, or interior] loaded 2" x 6" mullion profile. System uses a poured-in-place polyurethane thermal pocket to create its thermal break. System accommodates 1" glass thickness, with 1/4" as an option.

a. SSG – Structural Silicone Glazed Mullion.

2.2 MATERIALS AND ACCESSORIES

A. Aluminum Members: Provide 6063-T5 alloy and temper as recommended by manufacturer for strength, corrosion resistance, and application of required finish. Comply with ASTM B 221 for extrusions, and ASTM B 209 for sheet/plate. Provide 0.125" thick extrusions for door stiles and storefront framing. Provide 0.050" thick aluminum for glazing moldings.

B. Fasteners: Provide non-magnetic stainless steel fasteners, warranted by manufacturer to be non-corrosive and compatible with aluminum components.

C. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, or extruded aluminum 0.062" minimum, of an alloy and type selected by manufacturer for compatibility with other components.

D. Brackets and Reinforcements: Non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

E. Concrete/Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 123.

F. Bituminous Coatings: Cold-applied asphalt mastic compounded for 30-mil thickness per coat.

G. Compression Weatherstripping: Manufacturer's standard replaceable stripping of molded neoprene or PVC gaskets complying with ASTM D 2287.

H. Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing.

2.3 HARDWARE

A. Provide hardware units as indicated, scheduled, or required for operation of each door. Refer to Section 087100, Finish Hardware for hardware description.

2.4 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are indicated on Drawings. Any variable dimensions are indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

B. Prefabrication: To greatest extent possible, complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

1. Preglaze door and frame units to greatest extent possible, in coordination with installation and hardware requirements.

2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

C. Welding: Comply with recommendations of American Welding Society to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

D. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator to prevent corrosion.

E. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

F. Fasteners: Conceal fasteners.

G. Provide EPDM/vinyl blade gasket weatherstripping in bottom exterior door rail, adjustable for contact with threshold.

H. At interior doors and other locations without weatherstripping, provide neoprene silencers on stops to prevent metal-to-metal contact.

I. Provisions shall be made in the framing for minimum edge clearance, nominal edge cover, and nominal pocket width for the thickness and type of glazing installed, and shall be in accordance with the FGMA Glazing Manual.

J. Pocket glazed framing shall provide:

		Single Glass	Insulating Glass
1.	Nominal edge cover (or bite) framing only	5/16"	1/2"
2.	Min. nominal edge clearance	1/8"	1/4"
3.	Min. face clearance	1/8"	5/32"

2.5 STOREFRONT FRAMING

A. General: Provide inside-outside matched resilient flush glazed system with provisions for glass replacement. Shop fabricate and preassemble frame components where possible.

B. Thermal-Break Construction: Fabricate exterior aluminum storefront framing system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members, in manner which eliminates direct metal-to-metal contact. Provide manufacturer's standard construction which has been in use for similar projects for at least three years.

C. For glass and glazing, refer to Section 088000.

2.6 ALUMINUM DOORS

A. Aluminum entrance doors shall be thermally-broken, narrow-stile, factory-glazed aluminum doors manufactured by same manufacturer as storefront framing.

B. Aluminum entrance doors shall be stile and rail type swing doors. Aluminum shall be extruded aluminum conforming to ASTM B 221, 0.125" thick for door stiles and 0.050" thick for glazing molding.

1. Sections shall be of sizes and profiles indicated; shall present straight, sharply defined lines and arrises; and shall be free from defects impairing strength, durability, and appearance.

2. Fasteners where exposed shall be aluminum, stainless steel, or plated steel conforming to ASTM B 633.

C. Each door shall be factory glazed set in neoprene glazing gasket, refer to Section 088000 for glass.

D. Doors shall meet the following resistance to corner racking when tested by the Dual Moment Load Test.

1. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24" long and top rail section shall be 12" long.

2. Anchor top rail positively to test bench so that corner protrudes 3" beyond bench edge.

3. Anchor a lever arm positively to side rail at a point 19" from inside edge of top rail. Attach weight support pad at a point 19" from inner edge of side rail.

4. Test section shall withstand a load of 235 lbs. on the lever arm before reaching the point of failure, which shall be considered a rotation of the lever arm in excess of 45 deg.

E. For door hardware, refer to Section 087100.

F. Door bottom rail of exterior doors shall have an EPDM blade gasket sweep strip applied with concealed fasteners.

G. Corner construction shall consist of mechanical clip fastening, SIGMA deep penetration and fillet welds. Glazing stops shall be hook-in type with EPDM glazing gaskets.

H. The door weatherstripping on a single-acting, offset-pivot or butt-hung exterior door and frame (single or pairs) shall be thermoplastic elastomer weatherstripping of a tubular shape with a semi-rigid polymeric backing.

I. The door weatherstripping on a double-acting, center-pivoted door and frame (single or pairs) shall be pile cloth. The door bottom rail shall be weatherstripped with an EPDM blade gasket sweep strip applied with concealed fasteners.

J. The meeting stiles on pairs of doors shall be equipped with an adjustable astragal.

2.7 FINISH

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where aluminum entrances and storefronts are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install aluminum entrance doors and storefront framing in openings prepared under other Sections plumb, square, level, in exact alignment with surrounding work, with proper clearances, and securely and positively anchored to building structure, to meet performance requirements specified herein, in accordance with manufacturer’s published instructions and approved submittals.

B. Use only skilled mechanics for erection, under supervision of manufacturer’s representative.

C. Provide protection against galvanic action. Isolate dissimilar materials with bituminous coating or non-absorptive dielectric tape.

D. Install aluminum entrance doors, storefront frame, and finish hardware. Carefully fit and adjust doors and hardware to frames and weatherstripping. After erection check and adjust operating hardware for smooth and proper operation.

E. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Section 079200.

F. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances.

1. Variation from Plane: Limit variation from plane or location shown to 1/8" in 12 feet; 1/4" over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16". Where surfaces meet at corners, limit offset from true alignment to 1/32".

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8".

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing agency to perform testing indicated for storefronts.

B. Test fixed frames for water infiltration per AAMA 501.2; latest edition. Test within the first 10% of work complete, area to be a minimum of 100 SF of wall and including a perimeter where frames adjoin adjacent construction. Interior finishes must not interfere with observation of test area or be removed from test area. Not appropriate for operable doors.

1. This test (AAMA 501.2) shall be performed in the field on new construction.

C. Repair or remove Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.4 PROTECTION AND CLEANING

A. Protect finished metal surfaces from damage during fabrication, shipping, storage, and erection, and from then until acceptance by Owner.

B. Clean metal surfaces promptly after installation, exercising care to avoid damage. Remove excess sealant, dirt, and other substances. Lubricate hardware and other moving parts.

C. Replace glass that is broken, cracked or chipped prior to time of final acceptance of Project by Owner.

D. Clean glass surfaces promptly after installation, exercising care to avoid damage to same.

END OF SECTION

SECTION 084213.13 - SECURITY ALUMINUM ENTRANCES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the security aluminum entrances as indicated on the drawings and/or specified herein, including the following:

1. Bullet-resistant aluminum door assemblies.

1.3 RELATED SECTIONS

A. Joint Sealants - Section 079200.

B. Aluminum Entrances and Storefronts - Section 084113.

C. Aluminum Windows - Section 085113.

D. Finish Hardware - Section 087100.

E. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Mock-up: Install framing assembly at project site. Obtain Architect's approval prior to proceeding with installation of remaining storefront. Accepted mock-up may remain as portion of final work.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Loading

1. Wind Loading: ASCE-7 or Building Code, whichever is more restrictive.

2. Design Loads:

a. Positive (inward) design pressure of 45 psf.
b. Negative (outward) design pressure of 45 psf.

3. Deflection Limits

a. Deflection of any door member in a direction normal to the plane of the wall when subjected to the indicated design loads shall not exceed l/175 of its clear span or 3/4", whichever is less.

b. The deflection shall not exceed 50 percent of the nominal joint width at sealant joints occurring between framing members and adjacent materials, unless otherwise required by sealant manufacturer.
c. Upon reversal of load direction at magnitudes up to and including 1.5 times design pressures, slippage at fastened and/or clamped connections shall not exceed 1/8".
d. Glass deflection at full design load shall not exceed 1/100 of its span, or 3/4", whichever is less.
e. Metal panel deflection shall not exceed 1/90 of its span or 3/4", whichever is less. The span shall be taken as the lesser of the distances between the horizontal or vertical support members.

B. Thermal Movement

1. Provide for expansion and contraction of component materials as will be caused by surface temperatures ranging from 20 degrees F to a high temperature of 180 degrees F.

2. The expansion and contraction caused by temperature differential shall not cause buckling, undue stress on glass, failure of joint seals, undue stress on structural elements, demanding loads on fasteners, reduction of performance, or other detrimental effects.

C. Ballistic Resistant: Level 5 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing, glazing and panels.

1.6 SUBMITTALS

A. Product Data: For each type of door assembly, including manufacturer's recommended installation instructions.

B. Shop Drawings: Include plans, elevations, sections, details, attachment to other work, and glazing details.

C. Samples: For each exposed finish.

D. Product Test Reports: Indicating compliance with requirements.

E. Warranty: Sample of finish warranty.

F. Maintenance data.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays and to minimize on-site storage.

C. Protect doors, frames, and accessories in accordance with AAMA CW-10 "Care and Handling of Architectural Aluminum from Shop to Site" until Substantial Completion.

1.8 WARRANTIES

A. Finish Warranty: Manufacturer’s warranty against deterioration of factory finishes for the period of five (5) years from the date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Basis of Design: Insulgard HP500 Bullet-Resistant Architectural Aluminum Framing, level 5 by Insulgard Security Products; Phone 800.624.6315; website www.insulgard.com

1. Alternate Acceptable Manufacturers: Action Bullet Resistant, QMI, Riot Glass.

2. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable as approved by the Architect.

B. Description

1. Factory-fabricated door assembly constructed from either 6105-T5 or 6005-T5 extruded aluminum.

2. Dimensions: Medium stile door.

a. Top Rail and Stiles: 5 inches by 3-5/8 inches.
b. Bottom Rail: 10 inches by 3-5/8 inches.

2.2 GLAZING

A. Ballistic-Resistant Glazing Material: Ballistic Resistance Level 5, insulating, BALULN32IGU.

B. Glazing Gaskets

1. Interior: Closed cell neoprene (40-50 Shore 'A' Durometer).

2. Exterior: Solid neoprene (65-75 Shore 'A' Durometer).

2.3 DOOR HARDWARE

A. Provide manufacturer's standard door hardware, including:

1. Door Hardware

a. Von Duprin QEL 33 NL-OP Series Rim Device with electric latch retaction and rim cylinder.
b. Securiguard surface mounted cylinder guard.
c. Rockwood offset pull BF158.
d. Continuous hinge SL27HD with EPT.
e. LCN 4210 surface closer.
f. LCN 4210-18 drop plate and threshold and strike.

2.4 ACCESSORIES

A. Anchors: Fully concealed.

2.5 FABRICATION

A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.

B. Door corner joinery of extruded and keyed aluminum spline with a continuous 3/8 inch diameter steel tie rod at top and bottom rails.

2.6 FINISH

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where security aluminum entrances are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Verify field dimensions of opening prior to fabrication of door assemblies.

B. Coordinate structural requirements to ensure proper attachment and support.

3.3 INSTALLATION

A. Install doors and frames in accordance with manufacturer's recommendations and approved shop drawings.

B. Provide required support and securely fasten and set doors plumb, square, and level without twist or bow.

C. Apply sealant in accordance with door and sealant manufacturer's recommendations as indicated in installation instructions. Wipe off excess, and leave exposed sealant surfaces clean and smooth.

3.4 ADJUSTING AND CLEANING

A. Adjust door to provide for weather tightness and leave doors clean and free of debris.

3.5 PROTECTION

A. Protect doors and glazing from damage during construction operations. If damage occurs, remove and replace as required to provide doors in their original, undamaged condition.

END OF SECTION

SECTION 084333.13 - SECURITY STOREFRONTS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the security storefronts as indicated on the drawings and/or specified herein, including the following:

1. Bullet-resistant aluminum storefront framing, security level 5.

1.3 RELATED SECTIONS

A. Joint Sealants - Section 079200.

B. Aluminum Entrances and Storefronts - Section 084113.

C. Aluminum Windows - Section 085113.

D. Finish Hardware - Section 087100.

E. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Mock-up: Install framing assembly at project site. Obtain Architect's approval prior to proceeding with installation of remaining storefront. Accepted mock-up may remain as portion of final work.

1.5 PERFORMANCE REQUIREMENTS

A. Ballistic Resistant: Level 5 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing, glazing and panels.

1.6 SUBMITTALS

A. Product Data: For each type of framing and glazing including manufacturer recommended installation instructions.

B. Shop Drawings: Include plans, elevations, sections, details, attachment to other work, and glazing details for field-glazed units.

C. Samples: For each exposed finish.

D. Product Test Reports: Indicating compliance with requirements.

E. Warranty: Sample of finish warranty.

F. Maintenance data.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays and to minimize on-site storage.

1.8 WARRANTIES

A. Finish Warranty: Manufacturer’s warranty against deterioration of factory finishes for the period of five (5) years from the date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Basis of Design: Insulgard HP600 Bullet and Resistant Architectural Aluminum Framing by Insulgard Security Products; Phone 800.624.6315; website www.insulgard.com

1. Alternate Acceptable Manufacturers: Action Bullet Resistant, QMI, Riot Glass.

2. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable as approved by the Architect.

2.2 BULLET-RESISTANT STOREFRONT FRAMING

A. Bullet resistant Level V BR450 aluminum framing in a clear or dark bronze anodized finish, to be glazed with clear glass clad polycarbonate low spall, 1.60" thick and 18.02 lbs./ sq. ft.

B. One [1] approx. 15'-9" x 8'-0" fixed frame broken into four equal bays to include one intermediate horizontal mullion.

C. One [1] approx. 7'-9" x 8'-6" entrance to include a 3'-6" x 8'-3-1/2" full vision outswing door with a separate 3’-10” x 9’-8” sidelite to the left.

2.3 GLAZING

A. Ballistic-Resistant Glazing Material: Ballistic Resistance Level 5, insulating, unless otherwise noted.

2.4 ACCESSORIES

A. Anchors: Fully concealed in accordance with requirements of delegated design requirements.

2.5 FABRICATION

A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.

2.6 FINISH

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where security storefronts are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Verify field dimensions of opening prior to fabrication of windows.

B. Coordinate structural requirements to ensure proper attachment and support.

3.3 INSTALLATION

A. Install windows in accordance with manufacturer's recommendations and approved shop drawings.

B. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.

C. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions. Wipe off excess, and leave exposed sealant surfaces clean and smooth.

3.4 PROTECTION

A. Clean and protect windows from damage during construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.

END OF SECTION

SECTION 085113 - ALUMINUM WINDOWS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the aluminum windows as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Aluminum windows, interior and exterior.

2. Miscellaneous insulation at window frames.

3. Anchors, hardware, and accessories including trim pieces and panning.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Joint Sealants - Section 079200.

C. Glass and Glazing - Section 088000.

1.4 PERFORMANCE REQUIREMENTS (EXTERIOR)

A. Windows shall conform to the "Voluntary Specification for Aluminum Prime Windows & Sliding Glass Doors" as published by ANSI/AAMA 101/I.S.2-97 unless more stringent requirements are specified. Windows shall conform to minimum standards of AW-100 for fixed, hopper, awning, and casement windows.

B. Performance and Testing: Except as otherwise indicated, comply with air infiltration tests, water resistance tests and applicable load tests specified in ANSI/AAMA 101/I.S.2-97 for type and classification of window units required in each case.

1. Testing: Where manufacturer's standard window units comply with requirements and have been tested in accordance with specified tests, provide certification by manufacturer to the Architect and Owner showing compliance with such tests; otherwise, perform required tests through an AAMA-accredited testing laboratory or agency, and provide certified test results to the Architect and Owner.

2. Test reports shall be not more than four years old.

3. Sample submitted for tests shall be manufacturer's standard construction and whose overall dimensions shall be at least the lay-out size window and window/door unit required for this Project. Sequence of test shall be optional between manufacturer and the testing laboratory except that in all cases, air infiltration test shall be performed before water

resistance test. Sash in sample shall contain the approximate configuration as that of windows to be tested.

4. To evaluate testing and measure product performance, testing shall be conducted on manufacturer's standard product glazed with type of glazing material specified herein.

C. A thermal transmittance test and a condensation resistance test shall be conducted according to AAMA 1503-04, "Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections." Standard test conditions as specified in Section 9.1 of the 1503.1-04 shall be used. Windows shall meet the following minimum criteria:

1. Condensation Resistance Test (CRF)

a. With window sash and ventilators closed and locked, test unit in accordance with AAMA 1502.7.
b. Condensation Resistance Factor (CRF: See Drawings.

2. Thermal Transmittance Test (Conductive U-Value)

a. With window sash and ventilators closed and locked, test unit in accordance with AAMA 1503.0.
b. Conductive thermal transmittance (U-value: See Drawings.

D. Provide anchorage of window to building substrate to withstand pressure or suction winds loads per requirements of the New York State Building Code but not less than 30 psf.

E. Life Cycle Testing: When tested in accordance with AAMA 910-93, there is to be no damage to fasteners, hardware parts, support arms, activating mechanisms or any other damage which would cause the window to be inoperable at the conclusion of testing. Air infiltration and water resistance tests shall not exceed the primary performance requirements specified.

F. Fabricate and install window to allow for thermal movement of materials when subject to a temperature differential from –30 deg. F. to +180 deg. F. without damage of any finish.

1.5 QUALITY ASSURANCE

A. Manufacturers shall have been engaged in the manufacture of aluminum windows of grades specified for not less than 10 years.

B. Take field measurements of existing openings prior to submitting shop drawings and show same on shop drawings for each opening. Note that the Contract Drawings show general locations and sizes of windows, but the Contractor shall remain responsible for all field measurements, quantities, etc.

1.6 SUBMITTALS

A. Shop Drawings

1. Shop drawings shall show in detail and fully indicate the location and the quantities of all the work, the kind, finish, size, section of each unit, overall and detail dimensions, factory and field joint locations, arrangements and details, location and detail of each piece of anchorage, flashings, supporting construction provisions for the work of others.

2. Submit Shop Drawings and calculations showing fabrication and installation of window system including plans, elevations, sections, details of components, and attachments to other units of Work.

    a. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by a professional engineer licensed in the State of New York responsible for their preparation.

3. Shop drawings shall show all surrounding conditions on elevations and details, including steel, concrete, masonry, lintels, block, and anchorage; all correctly dimensioned.

4. Shop drawings of building elevations shall be at scale of 1/8" = 1'-0", or larger. Other shop drawings shall be at a scale that is normal to trade, or larger if required by Architect.

5. Contract drawings may not be used (reproduced, enlarged, reduced, etc.) by Subcontractor for shop drawings.

6. Shop drawings also shall fully demonstrate all requirements respecting the manufacture, finishing, handling, storage, carting sequence and erection of all materials specified herein.

7. Show joinery techniques, provision for horizontal and vertical expansion, drainage and weep systems, glass and metal thicknesses and framing member profiles.

8. Identify all materials, including metal alloys, glass types, fasteners, and glazing materials. Identify all shop and field sealants by product name and locate on drawings. Glazing details shall be at full size scale.

9. Show dimensioned position of glass edge relative to metal rabbet.

10. Shop drawings shall show attachments of window assemblies to adjoining construction and location of all work; kind, finish and size of frames, overall and detail dimensions, location and detail of each anchorage; supporting and adjoining construction; provision for the work of other trades; and all other required information.

11. Contractor shall verify all measurements of existing window openings in the field before commencing fabrication.

12. Any proposed deviations from work shown on the Contract drawings shall be indicated and so identified on shop drawings for Architect's review.

B. Samples

1. Submit 12" long sample of extrusion with specified finish.

2. Full size corner section of all types of aluminum frame, showing construction, glass and finishing - 12" x 12".

3. All fasteners, straps, hardware, locks and keys, sealant, etc.

C. Submit certified test results as required herein.

D. Warranty as noted in 1.9.

E. Window manufacturer and Contractor for work of this section must each submit references of prior projects similar in size, scope, and window type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be packed, loaded, shipped, unloaded, stored and protected in a manner which will avoid abuse, damage and defacement in accordance with the recommendations contained in the AAMA Aluminum Curtain Wall Manual #10 entitled "Care and Handling of Architectural Aluminum From Shop to Site."

B. Remove all paper type wrappings and interleavings that are wet or which could become wet when unloading materials.

C. Store inside structure in space designated by Owner.

D. Stack vertically or on edge so that water cannot accumulate on or within materials using wood or plastic shims between components to provide water drainage and air circulation.

E. Cover materials with tarpaulins or plastic hung on frames to provide air circulation and prevent contaminants from contacting aluminum.

F. Keep water away from stored assemblies.

G. The Contractor shall be responsible for taking the steps necessary to protect the materials from careless handling of tools, weld splatter, acids, roofing tar, solvents, abrasive cleaners, and other items that could damage window components and finish.

1.8 MANUFACTURER'S REPRESENTATIVE

A. Contractor shall require representative of manufacturer of the windows to provide field instructions and supervision of the installation of the windows.

B. Contractor shall require the manufacturer's representative to make sure that the subcontractor's workmen are fully instructed and trained in the handling and application of all the materials and shall see that all the materials are correctly installed.

C. Upon completion of the installation, the Contractor shall submit to the Architect in written form certification that the representative of the manufacturer of the windows has supervised the work of this Section and that all windows are correctly installed.

1.9 WARRANTY

A. Aluminum Windows and Related Materials: Ten (10) year warranty on materials and workmanship, including finish on aluminum and on glass and glazing.

PART 2 PRODUCTS

2.1 WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide aluminum windows made by Oldcastle Building Envelope, Jason Clarkson, 470-241-3562 or comparable product by Graham, Kawneer, Wausau, or an approved equal acceptable to the Architect.

1. Projected Windows: Signature Series - 5" Lap.

2.2 PROJECTED, FIXED AND CASEMENT WINDOWS

A. Aluminum Windows and Components

1. Extruded aluminum prime billet 6063-T5, aluminum sheet 5005 H32 (anodic) or 3003 H14.

2. Minimum principal window member wall thickness 1/8".

3. Minimum frame depth shall be 5" and sash depth 3-1/4". Vent to be flush with frame.

4. Maximum exposed metal sightlines of main frame members shall be 2" at all members except 3" at horizontal intermediate between fixed and operable areas.

5. Glass plane shall be recessed 1" from exterior plane of window members. Framing members shall possess a sloped profile duplicating an existing exterior putty glazed steel window profile.

6. There shall be no change in exterior sightlines between fixed and operable units including spandrel areas.

7. Vent sections must be tubes.

B. Hardware - General

1. All steel components 300 Series stainless steel (SS) (except roto-operator arms) i.e. - keepers, fasteners, hold open arms, tracks, etc.

2. All aluminum components 6063-T5 (T6) or 6105-T6.

3. Locking handles and cases, white bronze.

4. Hardware members bridging frame or vent thermal barrier to be nylon or suitable low conductivity, non-metallic material.

C. Thermal Barrier: Two strips crimped in place, 6/6 reinforced polyamide, separation 1-3/16".

D. Weatherstripping: Extruded sponge neoprene meeting ASTM C509.

E. Glass and Glazing: Shop glaze, see section 088000 for material description.

F. Fabrication

1. General

a. Finish, fabricate and shop assemble frame and sash members into complete windows under responsibility of one manufacturer.
b. No bolts, screws or fastenings to bridge thermal barriers or impair independent frame movement.

2. Casement Ventilator: Miter all corners and mechanically stake over solid aluminum, corner block minimum 1/4" thick, set and sealed in epoxy leaving hairline joinery, then seal weathertight. Joinery methods must not discolor finish or be unsightly.

3. Main Frame Members: Miter all corners and continuously weld along unexposed surfaces so as not to affect the structural or thermal integrity of the thermal barrier, then seal weathertight.

4. Weatherstripping

   a. Two rows (both inner and outer overlap contacts) of extruded neoprene meeting ASTM C 509 in extruded races about perimeter of operating sash.
   b. Securely stake and join at corners.

5. Glass Drainage: Provision shall be made to insure that water will not accumulate and remain in contact with the perimeter areas of sealed insulating glass.

6. Hardware

   a. Hinges
      1). Each operating sash shall be provided with a minimum of two extruded aluminum, three knuckle hinges with stainless steel pins. Windows over 4'-4" in height shall be provided with an intermediate hinge.
      2). The hinge shall be attached to both the frame and sash with concealed fasteners. The hinge shall be furnished to match the window.
   b. Locks
      1). Each operating sash shall be provided with a minimum of one die cast locking handle up to a ventilator height of 4'-0" and two locking handles on vents over 4'-0" high.
      2). All locking hardware shall be provided with a stainless steel strike backed up with an extruded aluminum leg a minimum of .125" in thickness. Locking directly against aluminum, will not be accepted.
   c. Riser Blocks: Each operating vent shall be equipped with a nylon riser block at the sill.

2.3 FINISH OF ALUMINUM

A. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

   1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

   2. Custom color and gloss as selected by the Architect.

B. Superior-Performance Organic FEVE Fluoropolymer Powder Finish: Single-coat Fluoropolymer Powder finish complying with AAMA 2605 and containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

   1. Custom color and gloss as selected by the Architect; refer to paint colors as indicated on the drawings.

PART 3 EXECUTION

3.1 INSPECTION AND REMOVALS

A. Examine surfaces and conditions where aluminum windows are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

B. Verify dimensions taken at the job site affecting the work. Bring field dimensions which are at variance to the attention of the Architect. Obtain decision regarding corrective measures before the start of installation.

3.2 INSTALLATION

A. Use only skilled tradesman with work done in accordance with approved Shop Drawings and specifications.

B. Plumb and align window faces in a single plane for each wall plane and erect windows and materials square and true adequately anchored to maintain positions permanently when subjected to normal thermal and building movement and specified wind loads.

C. Adjust windows for proper operation after installation.

D. Furnish and apply sealants to provide a weathertight installation at all metal-to-metal joints and intersections of frames and at opening perimeters. Wipe off excess material and leave all exposed surfaces and joints clean and smooth.

E. Aluminum shall be insulated from direct contact with steel, masonry, concrete, or non-compatible materials by bituminous paint, zinc chromate primer, or other suitable insulation material.

F. Blanket insulation shall be installed behind aluminum covers, panning and trim to insure thermally insulated seal.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.

2. Air-Infiltration Testing: RATES TO BE CONFIRMED BY ARCHITECT

a. Test Pressure: 6.24 PSF.
b. Fixed Maximum Rate: 0.09 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.
c. Operable Maximum Rate: 0.15 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.

3. Water-Resistance Testing: RATED TO BE CONFIRM BY ARCHITECT

   a. Test Pressure: 12 PSF (Note: No reduction in field test pressure will be allowed).
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.

5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING AND CLEANING

A. After completion of window installation, windows shall be inspected, adjusted, put into working order and left clean, free of labels, etc.

B. Glass that is broken, damaged, cracked, or permanently stained shall be replaced.

C. Final cleaning of finish shall be in accordance with AAMA 610.1.

END OF SECTION

SECTION 086300 - METAL-FRAMED SKYLIGHTS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the metal-framed skylights as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Metal-framed skylight.
2. Gaskets and fasteners.
3. Glass and glazing for skylights.

1.3 RELATED SECTIONS

A. Wood blocking - Section 062000.

B. Roofing - Division 7.

C. Sheet Metal Flashing - Section 076200.

D. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Work of this Section, including design, engineering, fabrication, finishing, preparation at the job site, erection and glazing of the skylight system shall be the responsibility of the skylight manufacturer. The manufacturer shall be regularly engaged in the preceding phases of construction of skylights and be able to demonstrate that he has successfully performed on comparable projects over the previous five (5) years.

B. Refer to Article 3.5 herein for field testing of skylight.

C. Pre-Construction Conference: Attend a pre-construction conference with the Owner, Architect, Contractor and all involved trades to discuss the work and coordination with other trades.

1.5 REFERENCES

A. Aluminum Association Incorporated (AA): SAS-30 Specifications for Aluminum Structures.

B. American Architectural Manufacturers Association (AAMA)

1. 501.3: Field Check of Water Penetration Through Installed Exterior Windows, Curtain Walls and Doors by Uniform Air Pressure Difference.

2. 2605.2: Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

3. Glass Design for Sloped Glazing.

4. Skylight Handbook Design Guide.

5. Sloped Glazing Guidelines.

C. American National Standards Institute (ANSI): Z97.1-1984 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

D. American Society for Testing and Materials (ASTM)

1. ASTM A 193: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

2. ASTM A 307: Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

3. ASTM B 209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. ASTM B 211: Specification for Aluminum-Alloy Bar, Rod, and Wire.

5. ASTM B 221: Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

6. ASTM B 316: Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods.

7. ASTM C 719: Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cycle Movement.

8. ASTM C 794: Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

9. ASTM C 1036: Specification for Flat Glass.

10. ASTM C 1048: Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

11. ASTM D 395: Test Methods for Rubber Property-Compression Set.

12. ASTM D 412: Test Methods for Rubber Properties in Tension.

13. ASTM D 1171: Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).

14. ASTM D 2240: Test Method for Rubber Property - Durometer Hardness.

15. ASTM E 283: Test Method for Rate of Air Leakage Through Exterior Window, Curtain Walls, and Doors.

16. ASTM E 330: Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

17. ASTM E 331: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

18. ASTM E 547: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.

19. ASTM E 773: Test Method for Seal Durability of Sealed Insulating Glass Units.

20. ASTM E 774: Specifications for Sealed Insulating Glass Units.

21. ASTM E 783: Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

E. Consumer Product Safety Commission (CPSC): 16CFR Part 1201 - Architectural Glazing Standards and Related Material.

F. Glass Association of North America (GANA): Glazing Manual.

G. Insulating Glass Certification Council (IGCC): Classification of Insulating Glass Units.

1.6 SYSTEM DESCRIPTION

A. Design Requirements

1. Extruded aluminum members with a system of alternate serrations for attachment of exterior glass retainers with 1/4" x 20 stainless steel screws and snap on aluminum caps.

2. Integral continuous interior guttering system within skylight framing members for positive drainage of condensation.

3. Skylights shall have weep holes to drain water to the exterior, one 3/8" diameter weep positioned within 6" of rafter base.

4. Finish glazed exterior horizontal joints with field applied structural silicone or fully capped system.

5. Full silicone wet seals along both sides of all exterior glass retainers.

6. Aluminum gutters, with insulation and pitched liners where shown on drawings.

B. Performance Requirements

1. Structural Members: Of sufficient sizes to support design loads of forty (40) psf live load, forty (40) psf wind load and fifteen (15) percent overload and 250 lbs. concentrated downward load applied anywhere on the surface without metal or glass failure. If prevailing Code requires greater loads, such greater loads shall comply.

2. The deflection of a framing member in a direction normal to the plane of glass when subjected to a uniform load deflection test in accordance with ASTM E 330, and per the above specified loads, shall not exceed 1/175 nor one (1) inch of its clear span for spans less than twenty (20) feet or 1/240 of clear spans greater than twenty (20) feet.

3. The deflection of a framing member in a direction parallel to the plane of the glass, when carrying its full dead load, shall not exceed an amount which will reduce the glass or panel

bite below seventy-five (75) percent of the design dimension and the member shall have a 1/8" minimum clearance between itself and the edge of the fixed panel, glass, or component immediately adjacent, nor shall it impair the function of or damage any joint seals.

4. Design Factor of Safety: All structural components of the skylights, including members, glazing stops, weldments, and connections shall be capable of withstanding a static air pressure difference of 1.5 times the total design load, positive and negative, maintained without glass breakage, damage or distress to fasteners, or any other components when tested in accordance with ASTM E 330. Permanent deformation of any frame or sash component after test-load release shall not exceed 1/500 of its span.

5. Air Infiltration: Infiltration averaged over frontal area of skylights shall not exceed 0.06 cfm/sf when subjected to 6.25 psf positive pressure and tested in accordance with ASTM E 283.

6. Water Penetration

    a. Water penetration is defined as any water exclusive of condensation that appears on the interior side.
    b. Any water that enters the skylight shall be controlled within it and drained through its exterior surfaces.
    c. Penetration shall not occur should skylights be subjected to the following inward pressures acting normal to any surface when exposed to a water discharge rate of five gallons of water per hour per square foot of frontal area and tested in accordance with the appropriate referenced specification.
        1). 15 psf static pressure for 15 minutes, ASTM E 331.
        2). 45 min. cycles at 15 psf with one (1) min., intervals at 0 psf with continuous water application per ASTM E 547.

7. Thermal Performance

    a. Provide for such expansion and contraction of component materials from –20 deg. F. to 180 deg. F. without causing buckling, stresses on glass, failure of seals, undue stress on structural elements, reduction of performance, or other detrimental effects.
    b. Average Thermal Conductance: Provide skylight systems with average U-factor of not more than 0.6 btu/h/ft^2/ºF when tested according to AAMA 1503. Architect may approve skylight systems with higher U-factors if thermal performance is limited by glazing requirements.

8. Where permitted by code, a 1/3 increase in allowable stress for wind or seismic load shall be acceptable, but not in combination with any reduction applied to combined loads. In no case shall allowable values exceed the yield stress.

9. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to the building structure and horizontal glazing bars or interior trim which are in contact with fifty (50) percent of the member's total depth.

10. Thermal breaks shall be assumed to have no ability to transfer shear stress for composite action of flexural members. Elements jointed by a thermal break shall be assumed to act separately.

11. The skylight framing shall be designed to exert no horizontal reactions under vertical gravity type loads, (dead, snow, live). Unbalanced live loads, (wind, seismic, etc.), acting upon the skylight will produce horizontal reactions that shall be resisted by the support structure.

1.7 SUBMITTALS

A. Prior to construction of the work, submit shop drawings for the fabrication and installation of all work and associated components.

1. Details of all work, at full scale as far as practical, showing metal and glass thicknesses, arrangement of components, of joining, details of all field connections and anchorage, field measurements, diagrams and details explaining provisions for thermal movement, waterproofing, fastening and sealing methods, glazing methods, insulation, metal finishes and all other pertinent information.

2. Include structural calculations for the work and its anchorage to the building structure and all materials and all connections fully dimensioned. Show ultimate factor of safety. Drawings and calculations shall bear the seal and signature of a professional Engineer licensed in the State of New York. All calculations shall be in accordance with the current design rules of the Aluminum Association, AISI, AISC, and ACI.

3. Show all dimensions including section thickness, frame lap over glass and edge clearance. Show tolerances for all dimensions including field dimensions, mill and shop dimensions and glass dimensions.

B. Submit samples of all materials to be encompassed in the work in size and quantity, as required by the Architect. These will include, but not be limited to, samples of:

1. Aluminum rafter component eighteen (18) inches long.

2. Each type and thickness of glass 12" x 12".

3. Gaskets, sealing materials, joint fillers, back-up rods and flashing.

C. Manufacturer's Literature: Submit technical descriptive data and installation instructions for each type of glass and glazing material.

D. Submit certification that skylight assembly, including glass, is capable of meeting performance criteria specified herein.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Verify the availability of all specified items upon Contract signing, and order in advance to avoid delays to the work. Certain materials may require considerable lead-time for delivery.

C. All materials are to be new. Handle, store, and install materials as recommended by the manufacturer except as required by these Specifications. Materials shall be delivered to the job site in their original containers with the manufacturer’s name, grade, number, and batch identification on the container or packaging.

D. Keep all materials dry while transported, stored, and delivered. Do not allow materials to be exposed to any moisture at any time, and promptly remove exposed materials from the site.

E. Store all materials on pallets and cover with canvas tarpaulins (not polyethylene), top to bottom.

F. Handle all materials to avoid damage. Promptly remove from site and materials rejected by the Architect.

G. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.9 WARRANTY

A. Manufacturer shall certify that skylight frame is free of defects in design, material, and construction, and that the skylight is warranted against leakage for a period of ten (10) years.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide extruded aluminum framed skylight Oldcastle/Vistawall BMS-3000 as detailed, or equal made by Acralight International Skylights, Naturalite/EPI Skylight Systems Inc., or Super Sky Products Co.

B. Representative: Jason Clarkson, 470.241.3562

2.2 MATERIALS

A. Framework

1. Principal Supporting Members: 0.125" minimum thickness extruded aluminum, alloy 6063-T5, 6063-T6, or 6061-T6 per ASTM B 221. Sizes, shapes, and profiles as indicated on Drawings.

2. Snap-On Covers and Miscellaneous Non-Supporting Trim: 0.062" minimum thickness extruded aluminum, alloy 6063-T5, per ASTM B 221.

3. Principal Formed Metal Members: 0.125" minimum thickness aluminum, alloy 6061-T6, per ASTM B 209.

4. Supporting Aluminum Gutters: Thickness as required by engineering calculations, based upon skylight reactions and applied design loads.

B. Glazing Strips

1. Type 1: Extruded heat cured silicone rubber or EPDM designed to prevent adhesion, and comply with the following specifications:

a. Hardness: ASTM D 2240 Type A, 50 ±5 durometer.
b. Tensile Strength: ASTM D 412 800 psi (minimum).
c. Elongation: Three-hundred (300) percent (minimum).
d. Tear, Die B, psi: Sixty-five (minimum).
e. Color: Black.

2. Compression Set: ASTM D 395, Method B, twenty-two (22) hours at 212 degrees F., twenty (20) percent (maximum).

3. Heat Aging Characteristics

   a. Seventy (70) hours at 212 degrees F.
   b. ASTM D 2240 Hardness Change: +3 durometer.
   c. ASTM D 412 Tensile Change: -10%.
   d. ASTM D 412 Elongation Change: -20%.

4. ASTM D 1171 Weather Resistance at one (1) part ozone per million, five-hundred (500) hours at 20% Elongation: No cracks.

5. No visual checks, cracks or breaks after completion of tests.

C. Setting Blocks: Extruded Type II silicone rubber designed to permit adhesion and comply with the following specifications:

1. Hardness: ASTM D 2240, Type A, 80 ±5 durometer.

2. Color: Black.

D. Fasteners

1. For Exterior Cap Retainers: ASTM A 193 B8 300 series stainless steel screws.

2. For Framework Connections: ASTM B 211 2024-T4 aluminum, ASTM A 193 B8 300 series stainless steel, ASTM B 316 aluminum rivets, as required by connection.

3. For Anchoring Skylight To Support Structure: Stainless steel size and type as shown on approved shop drawings.

E. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

F. Glass:

1. Standard Certification Requirements

   a. Float Glass: ASTM C 1036.
   b. Heat Treated Glass: ASTM C 1048, with surface stress of 5000 psi ±1500 psi.
   c. Laminated Glass: Two (2) lites interleaved with polyvinyl butyral (PVB). Units must meet criteria of ANSI Z97.1 and CPSC 16 CFR 1201 for safety glazing. Provide PVB layer of 0.060" for heat strengthened units.

d. Insulating Glass: CBA rated by the Insulating Glass Certification Council (IGCC) when tested in accordance with ASTM E 773 and ASTM E 774. Dual edge seals with secondary seal being silicone. Exterior lite of fully tempered glass and interior lite of laminated glass.

2. Performance Requirements

a. Probability of breakage not to exceed 8/1000 for vertical glass and 1/1000 for sloped glass upon first application of design wind and live load pressures. For glass selection, design wind pressure for a one (1) minute duration. For loads of longer duration use standard engineering practices for glass selection.
b. Probability of breakage due to anticipated thermal stress not to exceed 8/1000 for vertical glass and 1/1000 for sloped glass.

3. Provide one (1) percent attic stock of each glass size.

4. Glazing Unit Composition: 1-5/16" insulating glass consisting of 1/4" gray tinted tempered glass exterior lite; 1/2" air space, and 9/16" clear laminated tempered interior lite with a 0.060" PVB interlayer.

5. All glass shall meet the requirements of Section 088000.

G. Metal Flashing

1. Skylight Sill and Curb Flashing: Stainless steel AISI Type 304, 2D finish (dead soft fully annealed), 24 ga. Back-up plates for curb flashing: 22 ga.

2. Fasteners and Accessories for Stainless Steel:

a. Stainless steel screws, bolts, and washers as required.
b. Rivets For Stainless Steel Flashing Connections: Solid stainless-steel 3/16" dia. flat head rivets of proper length for material being fastened; pop-rivets are prohibited.
c. Do not use powder-activated or pneumatic fasteners.

3. Membrane Flashing for Joints: 0.060" thick, uncured EPDM flashing membrane; "Elastoform" by Carlisle, with primers and adhesives as required and supplied by the membrane manufacturer.

4. Bond Breaker: Polyethylene tape.

5. Solder: ASTM B 32, bar form, 60% block tin and 40% pig lead. Use an approved brand of solder flux.

H. Sealant

1. Structural Flush Glazed Joints: High performance silicone sealant applied in accordance with manufacturer's recommendations.

2. Non-Structural Flush Glazed Joints and Weather Seal Joints: Silicone sealants applied in accordance with manufacturer's recommendations.

3. Structural silicone sealant performance requirements:

a. Hardness: ASTM D 2240 Type A, 30 durometer.

b. Ultimate Tensile Strength: ASTM D 412, 170 psi.
c. Tensile at 150% Elongation: ASTM D 412, 80 psi.
d. Joint Movement Capability after 14 Day Cure: ASTM C 719, ± 50%.
e. Peel Strength (aluminum, glass, concrete) after 21 Day Cure: ASTM C 794, 50 psi.

4. Structural silicone shall not be used to support dead weight of vertical glass or panels.

2.3 FABRICATION

A. Construct skylight using extruded aluminum members.

B. Construct skylight using a continuous aluminum curb with expansion joints as required.

C. Insofar as practicable, fit and assemble work in manufacturer's shop. Work which cannot be permanently assembled shall be shop assembled, marked, and disassembled before shipment to the jobsite.

D. Design rafter bars for snap-in type glazing strips.

E. Attach snap-on cap retainers using stainless steel fasteners into a system of alternate serration's, at a maximum spacing of twelve (12) inches o.c.

F. Design snap-on cap retainer fasteners to provide not more than ten (10) lbs. per linear inch of compression on the glazing strips and glass edge.

G. Use snap-on type caps to conceal snap-on cap retainer fasteners.

H. Where applicable, shop rivet or weld aluminum clips to framing members, or field bolt at installation.

I. Set glass with glazing strips specified herein.

J. Use silicone setting blocks to support glass and to provide proper edge clearances and glass bites as outlined below, in accordance with GANA recommendations:

1. Set blocks not less than six (6) inches from edge of glass for support of unit.

2. Glass Bite: Not less than 1/2" or more than 5/8" on any side of a glass unit.

3. Maintain 1/4" edge clearance between glass and adjacent metal framework.

4. Use rubber spacers to maintain separation of glass and adjacent metal framework.

K. Locate weep holes in curb to positively drain condensation to exterior of skylight at each rafter connection.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where metal-framed skylights are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Contact between aluminum and dissimilar metals shall receive a protective coating of asphaltic paint for the prevention of electrolytic action and corrosion.

B. Do not start skylight installation until perimeter flashing systems are in place and (where applicable) roofing and flashing is completed at skylight curbs.

3.3 GENERAL WORKMANSHIP REQUIREMENTS

A. Substrates must be dry, clean, and smooth. Do not work in rain or winds gusting over 30 mph, temperatures below 40 deg F, or in presence of any water. Comply with applicable recommendations by manufacturers of all materials for workmanship and handling except as modified in this Section. Conform to the handling standards of the American Architectural Manufacturers Association (AAMA) Aluminum Curtain Wall Manual #10, "Care and Handling of Architectural Aluminum from Shop to Site." Provide convenient access to the Architect for observation.

B. All mechanics on this project shall be completely familiar with these Contract Documents and the approved shop drawings prior to any installation.

C. Do not permit the edges of the insulating glass to contact any solvents.

D. Do not dilute primers, solvents, cements, adhesives, coatings, or sealants. Keep containers closed except when removing materials from them.

E. Use gloves and tools free of dirt, grease, and other contaminants.

F. Coordinate installation of metal flashing with other trades. Isolate all dissimilar metal surfaces using a specified isolation layer as a separator.

G. All glass shall float in the opening and shall be fully separated from contacting mullions, fasteners, and other rigid components at all times, including while in service.

H. Seal joints watertight (as shown on drawings) with specified sealant unless otherwise indicated. Do not allow glazing sealants to impede drainage of water in the glazing rabbet; do not plug glazing pocket corners with sealant.

I. Glazing pockets shall weep to the exterior at the sill of each opening. Systems shall not direct water to contact edges of insulating glass units. Prevent water infiltration at weeps. Coordinate gutter and weep systems with other sections and surrounding work.

J. Allow gaskets to relax and recover several hours prior to installation. All gaskets shall be oversized 1% to 2% in length beyond the daylight dimensions for the glass. Install gaskets by inserting gaskets at ends and center first, then crowding remainder of gasket length into the race. Seal gasket corners with silicone sealant.

K. If installation cannot be completed before the end of a work day, cover opening with plywood and make watertight.

L. For installation of glazing, follow all procedures and reference standards contained in Section 088000, "Glass and Glazing."

3.4 INSTALLATION

A. Install skylight frame, glass and accessory items as needed in accordance with manufacturer's instructions.

B. Install skylight system under the direction of the skylight manufacturer's own mechanics. Coordinate the installation of the first skylight with the Architect so that he can be present. Installation methods shall be established during first installation. First installations shall serve as model for installation of balance of work.

C. Erect system plumb and true, in proper alignment and relation to established lines and grades as shown on approved shop drawings.

D. Anchor skylight to structure in strict accordance with approved shop drawings. Inspect frames immediately before placing into opening for any damage, including for finish damage and discontinuous frame corner seals. Report damaged components to the Architect for direction. Repair damage to the satisfaction of the Architect or Architect's representative. If satisfactory repair of damaged component is not possible, replace with new undamaged component.

E. Use high performance silicone sealants to seal horizontal joints between glass panels and silicone sealant to wet seal joints between snap-on cap retainers and glass.

F. Apply sealing materials in strict accordance with sealant manufacturer's instructions. Before application, remove mortar, dirt, dust, moisture, and other foreign matter from surfaces it will contact. Mask adjoining surfaces to maintain a clean and neat appearance. Tool sealing compounds to fill the joint and provide a smooth finish.

3.5 TOLERANCES

A. All parts of the work, when completed, shall be within the following tolerances:

1. Maximum Variation from Plane or Location Shown on Approved Shop Drawings: 1/8" per twelve (12) feet of length or 1/2" in total length.

2. Maximum Offset from True Alignment Between Two Members Abutting End to End, Edge to Edge in Line or Separated by Less than Three (3) Inches: 1/32".

3.6 FIELD QUALITY CONTROL

A. Water Leakage Testing: Employ an independent testing agency to perform water leakage testing of completed portions of the skylight systems.

1. Test Procedure: AAMA 501.2.

2. Testing Parameters:

a. Locations: Perform testing in at least four locations on the skylights.
b. Water Application Pressure: 35 psi.
c. Test Duration: 2 min/ft. of joint being tested (each tested location shall consist of 5 ft. of joint).
d. Passing Criterion: No visible water on the interior of the skylights. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

3. Submit a test report describing the conditions of the test and its results.

B. If a test fails, two (2) or more locations shall be re-tested at Contractor's expense.

3.7 CLEANING

A. Install skylight frame and associated metal to avoid soiling or smudging finish.

B. Clean glass at time of installation.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 06 Section “Rough Carpentry”.
2. Division 06 Section “Finish Carpentry”.
3. Division 08 Section “Hollow Metal Doors and Frames”.
4. Division 08 Section “Flush Wood Doors”.
5. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
6. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity.

Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties 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. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Hager Companies (HA) - BB Series, 5 knuckle.
b. Ives (IV) - 5BB Series, 5 knuckle.
c. McKinney (MK) - TA/T4A Series, 5 knuckle.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

a. Hager Companies (HA).
b. Ives (IV).
c. Pemko (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. Hager Companies (HA) - ETW-QC (# wires) Option.
b. Ives (IV) - Connect.
c. McKinney (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Pemko (PE) - EL-CEPT Series.
    b. Securitron (SU) - EL-CEPT Series.
    c. Von Duprin (VD) - EPT-10 Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. Hager Companies (HA) - Quick Connect.
    b. Falcon (FA) - Connect.
    c. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

    a. Door Controls International (DC).
    b. Rockwood (RO).
    c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

4. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood (RO).
    c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.

2. Manufacturers:

    a. Corbin Russwin (RU) - Access 3 AP.
    b. Sargent (SA) - Degree DG1.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.

3. New System: Key locks to a new key system as directed by the Owner.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Heavy duty mortise locks shall have a ten-year warranty.

2. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180-degree viewing angle with protective covering to prevent tampering.

3. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9000 Series.

2.8 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. Manufacturers:

   a. Corbin Russwin Hardware (RU) - ML20900 Series.
   b. Sargent Manufacturing (SA) - 8200 Series.
   c. Schlage (SC) - L9000 EL/EU/RX Series.

B. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty, High Security Monitoring): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. High Security Monitoring: Provide lock bodies which have built-in request to exit monitoring and are provided with accompanying door position switches. Provide a resistor configuration which is compatible with the access control system.

4. Manufacturers:

   a. Corbin Russwin Hardware (RU) - ML20600 NAC Series.

b. Sargent Manufacturing (SA) - NAC 8200 Series.

2.9 STAND ALONE ACCESS CONTROL LOCKING DEVICES

A. Stand Alone Electronic Keypad Locksets: Internal, battery-powered, self-contained ANSI Grade 1 mortise or cylindrical lock consisting of electronically motor driven locking mechanism and integrated keypad without requirements for separate electronic programming devices. Locks to accept standard, interchangeable (removable) core, security and high security override cylinders. Provide keypad locks with a minimum 100 user codes furnished standard with 6 "AA" batteries and non-volatile memory.

1. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Manufacturers:

a. Sargent Manufacturing (SA) - KP Series.

2.10 AUXILIARY LOCKS

A. Mortise Deadlocks, Large Case: ANSI/BHMA A156.13 Grade 1 Certified Products Directory (CPD) listed large case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. One piece stainless steel bolts with a 1" throw. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9460 Series.

2.11 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.12 ELECTRIC STRIKES

A. Heavy-Duty Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings designed to accommodate pre-load on fail secure models. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe and where specified provide latchbolt monitoring.

1. Manufacturers:

   a. HES (HS) - 7000/7500 Series.

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.13 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.

2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 XP Series.

2.14 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

4. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 XP Series.

2.15 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. LCN Closers (LC) - 4040XP Series.
b. Norton Rixson (NO) - 9500 Series.
c. Sargent Manufacturing (SA) - 281 Series.

C. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or

aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

   a. LCN Closers (LC) - 4040 Series.
   b. Norton Rixson (NO) - 7500 Series.
   c. Sargent Manufacturing (SA) - 351 Series.

2.16 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

   a. Hiawatha, Inc. (HI).
   b. Rockwood (RO).
   c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

   a. Norton Rixson (RF).
   b. Rockwood (RO).
   c. Sargent Manufacturing (SA).

2.17 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).

2.18 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 3280 Series.
b. Security Door Controls (SD) - DPS Series.
c. Securitron (SU) - DPS Series.

B. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.

1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

2. Manufacturers:

   a. Securitron (SU) - AQL Series.
   b. Altronix (AS) - Maximal 11F.

2.19 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.20 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. SA - SARGENT
5. AD - Adams Rite
6. RF - Rixson
7. NO - Norton
8. OT - Other
9. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 128, 131

1	Continuous Hinge	FM__SLF-HD1 x PT		PE	
1	Rim Exit Device, Storeroom	DG164 16 55 56 AD8504 863	US32D	SA	⚡
1	Core	DG1 6300	US15	SA	
1	Surface Closer	9500 / P9500	689	NO	
1	Door Stop	RM850 / RM860	US26D	RO	
1	Threshold	to architect detail		PE	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	⚡
1	Wiring Diagram	Point to Point			
1	Position Switch	DPS-M/W-BK		SU	⚡
1	Card Reader	by Security System Supplier		OT	
1	Power Supply	AQL Series (Amps & Relays as Required)		SU	⚡
1	Electric Power Transfer	EL-CEPT	630	SU	⚡

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 2.0

Doors: 100

1	Continuous Hinge	FM__SLF-HD1		PE	

1	Rim Exit Device, Storeroom	DG164 16 AD8504 863	US32D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	Threshold	to architect detail		PE

Set: 3.0

Doors: 12A

1	Continuous Hinge	FM__HD1		PE
1	Rim Exit Device, Exit Only	8810 EO	US32D	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	Gasketing	290APK x 2891APK		PE
1	Local Alarm	By Security System Supplier		OT
1	Position Switch	DPS-M/W-BK		SU

Set: 4.0

Doors: 101A

1	Continuous Hinge	FM__HD1 PT		PE
1	Rim Exit Device, Storeroom	DG164 16 55 8804 ETB	US32D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	Threshold	to architect detail		PE
1	Gasketing	290APK x 2891APK		PE
1	Sweep	18061CNB		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
1	Electric Power Transfer	EL-CEPT	630	SU

Notes:

Set: 5.0

Doors: 135

1	Continuous Hinge	FM__HD1 PT		PE	
1	Fail Secure Lock	DG164 8273 LNB	US26D	SA	⚡
2	Core	DG1 6300	US15	SA	
1	Conc Overhead Stop	1-X36	630	RF	
1	Surface Closer	9500 / P9500	689	NO	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	⚡
1	Wiring Diagram	Point to Point			
1	Position Switch	DPS-M/W-BK		SU	⚡
2	Card Reader	by Security System Supplier		OT	
1	Power Supply	AQL Series (Amps & Relays as Required)		SU	⚡
1	Electric Power Transfer	EL-CEPT	630	SU	⚡

Notes: Door closed & locked at all times. Presenting valid credential either shunts door position switches & allows for authorized entrance. With loss of power door remains locked.

Set: 6.0

Doors: 121A

2	Continuous Hinge	FM__HD1		PE	
1	Dust Proof Strike	570	US26D	RO	
2	Flush Bolt	555	US26D	RO	
1	Storeroom/Closet Lock	DG164 8204 LNB	US26D	SA	
1	Core	DG1 6300	US15	SA	
2	Conc Overhead Stop	1-X36	630	RF	
1	Surface Closer	9500 / P9500	689	NO	
1	Threshold	to architect detail		PE	
1	Gasketing	290APK x 2891APK		PE	
2	Sweep	18061CNB		PE	
2	Astragal	18041CNB		PE	
1	Position Switch	DPS-M/W-BK		SU	⚡

Notes: Audible Alarm by others

Set: 7.0

Doors: 303B

2	Continuous Hinge	FM__HD1		PE
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Dormitory/Exit Lock	DG164 8225 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
2	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	Threshold	to architect detail		PE
1	Gasketing	290APK x 2891APK		PE
2	Sweep	18061CNB		PE
2	Astragal	18041CNB		PE
2	Position Switch	DPS-M/W-BK		SU

Notes: Local Alarm by others.

Set: 8.0

Doors: 31A, 32

1	Continuous Hinge	FM__HD1		PE
1	Dormitory/Exit Lock	DG164 8225 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	Threshold	to architect detail		PE
1	Gasketing	290APK x 2891APK		PE
1	Sweep	18061CNB		PE
1	Position Switch	DPS-M/W-BK		SU

Notes: Local Alarm by others

Set: 9.0

Doors: 106A

1	Continuous Hinge	FM__SLF-HD1 x PT		PE
1	Deadlatch	4900	628	AD
1	Paddle Operator	4591MA-02-00	US26D	AD
1	Cylinder	as required	US15	SA
1	Core	DG1 6300	US15	SA
1	Electric Strike	7400	628	AD

1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
1	Power Supply	AQL Series (Amps & Relays as Required)		SU
1	Electric Power Transfer	EL-CEPT	630	SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 10.0

Doors: 101

1	Continuous Hinge	FM__SLF-HD1 x PT		PE
1	Rim Exit Device, Storeroom	DG164 16 55 56 AD8504 863	US32D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Surface Closer	9500 / P9500	689	NO
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU
1	Electric Power Transfer	EL-CEPT	630	SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 11.0

Doors: 122A

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Rim Exit Device, Storeroom	DG164 12 8804 ETB	US32D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 12.0

Doors: 121

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Rim Exit Device, Storeroom	DG164 16 8804 ETB	US32D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
3	Silencer	608		RO

Set: 13.0

Doors: 11A

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Rim Exit Device	DG164 12 8816 ETB	US32D	SA
2	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE

Set: 14.0

Doors: 11, 12, 21, 22

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Electrified Mortise Lock	DG164 IDP NAC-82270 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO

1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunts integrated door position switch and allows authorized egress at all times. With loss of power or activation of building fire system door remains unlocked.

Set: 15.0

Doors: 303, 304

5	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Electrified Mortise Lock	DG164 IDP NAC-82271 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
2	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
2	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 15.1

Doors: 122

5	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Electrified Mortise Lock	DG164 IDP NAC-82271 LNB	US26D	SA
2	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	Gasketing	S773BL		PE
1	Astragal	S771x6BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
2	Position Switch	DPS-M/W-BK		SU
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 16.0

Doors: 103, 108, 215, 222, 231, 234, 302

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Electrified Mortise Lock	DG164 IDP NAC-82271 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		

1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Set: 17.0

Doors: 104, 106, 107, 129, 303A, 304A, 305

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Electrified Mortise Lock	DG164 IDP NAC-82271 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Set: 18.0

Doors: 126A

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Fail Safe Lock	DG164 8272 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO

1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
2	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential either shunts door position switches & allows for authorized entrance. With loss of power door remains unlocked.

Set: 19.0

Doors: 126

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QC	US26D	MK
1	Fail Safe Lock	DG164 8272 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	Point to Point		
1	Position Switch	DPS-M/W-BK		SU
2	Card Reader	by Security System Supplier		OT
1	Power Supply	AQL Series (Amps & Relays as Required)		SU

Notes: Door closed & locked at all times. Presenting valid credential either shunts door position switches & allows for authorized entrance. With loss of power door remains unlocked.

Set: 20.0

Doors: 237, 301, 302A

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Dust Proof Strike	570	US26D	RO

2	Flush Bolt	555	US26D	RO
1	Storeroom/Closet Lock	DG164 8204 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
2	Conc Overhead Stop	1-X36	630	RF
2	Silencer	608		RO

Set: 21.0

Doors: 132, 134

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Storeroom/Closet Lock	DG164 8204 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
2	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	Gasketing	S773BL		PE
1	Astragal	S771x6BL		PE

Set: 22.0

Doors: 204, 218, 306

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	DG164 8204 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 23.0

Doors: 116

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	DG164 8204 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
3	Silencer	608		RO

Set: 24.0

Doors: 211, 212, 213, 223, 224

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Office/Entry Lock	DG164 8205 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 25.0

Doors: 207, 208, 209, 216, 221

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	DG164 8237 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 26.0

Doors: 120, 211A, 212A, 214, 215A, 232

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	DG164 8237 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
3	Silencer	608		RO

Set: 27.0

Doors: 109, 110, 111

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	DG164 8237 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 28.0

Doors: 111A

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	DG164 8237 LNB	US26D	SA
1	Core	DG1 6300	US15	SA

1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
3	Silencer	608		RO

Set: 29.0

Doors: 102

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V21 8265 LNB	US26D	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 30.0

Doors: 203

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V21 8265 LNB	US26D	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
3	Silencer	608		RO

Set: 31.0

Doors: 202, 210, 217, 229

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNB	US26D	SA
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 32.0

Doors: 228, 230

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNB	US26D	SA
1	Conc Overhead Stop	1-X36	630	RF
3	Silencer	608		RO

Set: 33.0

Doors: 133, 235, 236

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNB	US26D	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 34.0

Doors: 231A, 238

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNB	US26D	SA
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
3	Silencer	608		RO

Set: 35.0

Doors: 105, 107A, 31

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNB	US26D	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
1	Gasketing	S773BL		PE

Set: 36.0

Doors: 113, 114, 114A, 115, 115A, 117, 118, 119, 205, 206, 219

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Push Pull	BF 111x73C/73CL	US32D	RO
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 37.0

Doors: 220

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Push Pull	BF 111x73C/73CL	US32D	RO
1	Conc Overhead Stop	1-X36	630	RF

1	Door Closer	7500 / P7500	689	NO
3	Silencer	608		RO

Set: 38.0

Doors: 112

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Keypad Mortise Lock	DG164 KP8276 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 39.0

Doors: 225, 226

3	Hinge, Full Mortise, Hvy Wt	H T4A3786	US26D	MK
1	Deadlock	DG164 8220	US26D	SA
1	Core	DG1 6300	US15	SA
1	Flush Pull	94Px94L	US32D	RO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 40.0

Doors: 127, 227

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Institutional Privacy Lock	DG164 V20 8257 LNB	US26D	SA
1	Core	DG1 6300	US15	SA
1	Conc Overhead Stop	1-X36	630	RF
3	Silencer	608		RO

Set: 41.0

Doors: 135A, 135B

1	Cylinder	as required	US15	SA
1	Core	DG1 6300	US15	SA

Notes: Balance of hardware by assembly supplier.

Set: 42.0

Doors: 123, 124, 125

1 All Hardware	By Assembly Manufacturer	OT

END OF SECTION 087100

SECTION 088000 - GLASS AND GLAZING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the glass and glazing as shown on the drawings and/or specified herein, including, but not limited to, glazing of the following:

1. Windows.
2. Doors.
3. Entrances.
4. Storefront framing.
5. Interior borrowed lites.
6. Interior frameless mirrors.
7. Bullet-resistant glazing.
8. One-way mirror glass.

1.3 RELATED SECTIONS

A. Steel Doors and Frames - Section 081113.

B. Aluminum Entrances and Storefronts - Section 084113.

C. Security aluminum entrances – Section 084213.13.

D. Aluminum Windows - Section 085113.

E. Metal-Framed Skylights - Section 086300.

F. Framed bathroom mirrors - Section 102813.

1.4 REFERENCES

A. Comply with the recommendations of the following references unless more stringent requirements are indicated herein.

1. FGMA Publications: FGMA Glazing Manual.
2. AAMA Publications: AAMA TIR-A7 Sloped Glazing Guidelines and Glass Design for Sloped Glazing.

3. LSGA Publications: LSGA Design Guide.

4. IGMA Publications: TM-3000 Vertical Glazing Guidelines and TB-3001 Sloped Glazing Guidelines.

5. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201, Safety Standards for Architectural Glazing, Sealed Insulating Glass Manufacturing Association.

6. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

7. ASTM C 920, Standard Specification for Elastomeric Joint Sealants.

8. Insulating Glass Criteria: IGCC International Glass Certification Council.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated on drawings and/or specified herein are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Specified Design Wind Loads: Per ASCE-7.

2. Probability of Breakage for Vertical Glazing

   a. 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
   b. 1 lite per 1000 for lites installed 15 degrees from the vertical and under wind action.
   c. Load Duration: 60 seconds or less.

3. Maximum Lateral Deflection: For glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/100 times the short side length or 1/2", whichever is less.

4. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   a. Temperature Change (Range): 120 deg. F ambient; 180 deg F, material surfaces.

5. Thermal Solar Performance: See Article 2.2 herein.

C. Glass units shall be annealed, heat-strengthened, fully tempered or laminated where required to meet wind and/or snow loads and safety glazing requirements as shown, specified or recommended by the glass fabricator and as required by the New York State Building Code.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements, including performance requirements.

B. Submit compatibility and adhesion test reports from sealant manufacturer indicating materials were tested for compatibility and adhesion with glazing sealant, as well as other glazing materials including insulation units.

C. Verification Samples: Submit representative samples of each glass and glazing material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide glass samples having minimum size of 144 sq. in. and 6 in. long samples of sealants and glazing materials; all samples shall bear the name of the manufacturer, brand name, thickness, and quality.

D. Calculations: Provide wind load charts, calculations, thermal stress analysis, and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied. Document shall be signed and sealed by a Professional Engineer licensed in the State of New York.

E. Test Reports: Provide certified reports for specified tests.

F. Warranties: Provide written warranties as specified herein.

1.7 QUALITY ASSURANCE

A. Source: For each glass and glazing type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Installer: A firm with a minimum of five years' experience in type of work required by this Section and which is acceptable to manufacturers of primary materials; and with a successful record of in-service installations similar in size and scope to this Project.

C. Glass Thickness: Glass thicknesses shown on drawings and/or specified herein are minimum thicknesses. Determine and provide size and thickness of glass products that are certified to meet or exceed performance requirements specified in this Section.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

1. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."

2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines for Sealed Insulating Glass Units."

E. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

F. Safety Glazing Products: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum provide Category II materials complying with testing requirements in 16 CFR Part 12 and ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council.

a. For glazing types with multiple lites of glass, laminated or assembled into an insulating unit, where safety labeling is required, provide labels that align in position and orientation from lite to lite.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

3. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

G. Insulating Glass Certification Program: Permanently marked on spacers with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

2. Associated Laboratories, Inc.

3. Insulating Glass Manufacturers Alliance.

H. Manufacturer shall be ISO 9001-2000 Certified.

1.8 TESTS

A. Preconstruction Sealant Test: Submit samples of materials to be used to glazing sealant manufacturer to determine sealant compatibility. Include samples of glass, gaskets, glazing materials, framing members, and other components and accessories of glazing work. Test in accordance with ASTM C 794 to verify what type of primers (if any) are required to ensure sealant adhesion to substrates.

1. Submit minimum of nine pieces of each type and finish of framing member, and nine pieces of each type, class, kind, condition, and form of glass, including monolithic, laminated, and insulating glass for adhesion tests.

2. Provide manufacturer's written report and recommendations regarding proper installation.

1.9 PROJECT CONDITIONS

A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within limits established by manufacturers of materials and products used.

B. Temperature Limits: Install sealants only when temperatures are within limits recommended by sealant manufacturer, except, never install sealants when temperatures are below 40 deg. F.

C. Do not install sealants when substrates are wet or where contaminants capable of interfering with adhesion are present.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations and GANA Manual.

1. Protect materials from moisture, sunlight, excess heat, sparks and flame.

2. Sequence deliveries to avoid delays, but minimize on-site storage.

3. Glass shall be delivered to the site bearing the manufacturer's label, complete with glazing instructions where applicable.

4. Comply with insulating glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 WARRANTIES

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Manufacturer's Special Project Warranty on Coated Glass Products: Provide written warranty signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, within specified warranty period indicated below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects are defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.

1. Warranty Period: Manufacturer's standard but not less than five (5) years after date of substantial completion.

C. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of the hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

1. Warranty Period: Manufacturer's standard but not less than ten (10) years after date of substantial completion.

D. Manufacturer's Special Project Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated glass manufacturer agreeing to replace laminated glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty period five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/FABRICATORS

A. All glass and glazing used at the exterior of the Project shall be manufactured by the same manufacturer. The same manufacturer and the same furnace shall be used for all tempered and heat strengthened glass used throughout the project. Acceptable manufacturers include, but are not limited to, the following:

1. Vitro Architectural Glass.

2. Guardian Industries.

3. Pilkington.

4. Viracon.

2.2 GLASS MATERIALS AND PRODUCTS

A. Clear Float Glass: ASTM C 1036, Type I (transparent, flat), Class 1 (clear), Quality q3, minimum 1/4" thick.

B. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated), Type I (transparent, flat), Class 1 (clear), Quality q3, Kind FT, minimum 1/4" thick. Tempered glass must be certified by SGCC to meet applicable standards.

1. Performance Requirements for Tempered Glass

a. Length and Width: For 2.9 mm to 6.0 mm; +/-1.6 mm.
b. Diagonal: +/- 3.0 mm.
c. Edgework: Belt seaming or diamond wheels. 1.5 mm seam of upper and lower glass edges. No sharp edges.
d. Corners: No more than 3.0 mm from square.
e. Float Glass Defects: Must meet the requirements of ASTM C 1036. The most common defects are scratches, stones gaseous bubbles and edge chips. Tables in the glass standards have limits for size/quantity of defects.
f. Tempered glass shall have a minimum surface compression of 10,000 psi.
g. Tempered glass to be heat-treated by horizontal (roller hearth) process with inherent roller-wave distortion parallel to the bottom edge of the glass when installed.
h. Flatness Tolerances
1). Roller-Wave or Ripple: The deviation from flatness at any peak shall be targeted not exceed 0.003" as measured per peak to valley for ¼" (6mm) thick glass.
2). Bow and Warp: The bow and warp tolerances shall not exceed 1/32" per linear foot.

3). Fully tempered glass shall be heat soaked to EN 14179-1:2016-European Heat Soaking Standard.

C. Laminated Safety Glass: Provide two glass panes of equal thickness, laminated together with a polyvinyl butyl interlayer, conforming to ASTM C 1172 and as follows:

1. Interlayer Color: As selected by Architect.

2. Interlayer Material: Provide Eastman Chemical "Saflex" or "Vanceva," or DuPont "Butacite," 0.030" thick at vertical applications, and 0.060" thick at sloped or horizontal applications.

3. Minimum thickness of 1/4".

D. Insulating Glass: Insulating glass unit shall consist of 1/4" clear exterior lite of float (or tempered, where required) glass with low-E coating on No. 2 face, 1/2" interspace and 1/4" clear interior lite of float (or tempered, where required) glass. Provide factory assembled units of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space, complying with ASTM E 2190, and as follows:

1. Sealing System: Dual Seal.

2. Primary Sealant: Polyisobutylene.

3. Secondary Sealant: Silicone, General Electric IGS 3204 or IGS 3100, or Dow Corning 982.

   a. For structurally glazed IG units, secondary seal shall conform to ASTM C 1249.
   b. Primary and secondary seals shall not contain voids and must be continuously bonded to the glass structure.

4. Spacer: Clear finish aluminum with welded, soldered, or bent corners, hollow tube types, filled with low nitrogen absorption desiccant.

5. Desiccant: Molecular sieve, silica gel, or blend of both.

6. Interspace Content: Argon.

7. Air Space Thickness: 1/2".

8. Glass Thickness: 1/4" minimum.

9. Low-E Coating: Provide high-performance, clear, metallic coating, VE1-2M as manufactured by Viracon or approved equal. Provide low-E coating having the following performance characteristics when applied to the No. 2 surface of 1" insulating units, both lites 1/4" clear:

   a. Visible Light Transmittance: 70%.
   b. Solar Energy Transmittance: 33%.
   c. Solar Heat Gain Coefficient (SHGC): 0.38.
   d. U-Value: 0.29 winter, 0.26 summer.

10. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) or by IGMA and tested in accordance with the above ASTM Test Methods.

11. Insulating glass shall conform to the following tolerances:

    a. Length and Width: + 3.0 mm/ -2.0 mm.
    b. Diagonal: +/- 3.0 mm.
    c. Thickness: As agreed +/- 1.0 mm.
    d. Edge-Deletion of Coating: Minimum 8 mm wide. Width of deletion must be more than the width of the secondary seal. Silver layer(s) must be completely removed. Appearance must be uniform.
    e. Primary PIB Seal: Must be complete with no breaks. Appearance must be uniform. PIB bead must overlap coating. No visible bright line when glass is viewed in transmission. The width of the PIB bead shall be 4.0 mm + 3.0/ - 1.5 mm.
    f. Secondary Seal: Nominal 6 mm + 3.0/ - 1.5 mm. The minimum width of the secondary silicone seal for IG units that are glazed structurally must be determined according to ASTM C 1249. The secondary seal must be uniformly applied without bubbles, cavities or gaps. Avoid excess sealant that will need to be trimmed off later.

12. Additional requirements and properties for primary and secondary insulating glass seals and spacers:

    a. All glass units shall comply with IGMA Guidelines which limits the dimension of the visible edge seal encroachment into the vision area to be no greater than the sightline infringement of 3mm (0.12").
    b. Insulating glass unit hermetic seal to consist of butyl primary and silicone secondary seals with bent, welded, or soldered interpane spacer corners; keyed corners are not acceptable unless also soldered or welded. Spacers shall be aluminum or stainless steel. Locate spacer joint at the top or sides of the units, but in no instances at the sill. Design units to minimize the number of spacer joints. Provide solid keys, embedded in butyl sealant on all four sides, at spacer joints.
    c. Hermetic seals must be continuous and intimately bonded to both lites of glass. Provide primary seal of uniform depth with a nominal width of 1/8" to 3/16". Hermetic seals shall not be contaminated with debris, fingerprints, or other foreign matter and shall not contain voids or air pockets that decrease the width of the seal below the minimum widths listed in these Specifications, or that breach the seal. The width of the primary seal shall not be less than 1/16", and the total cumulative length of the primary seal between 1/16" and 1/8" shall be less than 12" in any one insulating glass unit. The primary seal shall not have a reduced thickness at the corners. An increased thickness of the primary seal at the corners is acceptable.
    d. Provide secondary seal of uniform depth with a nominal width of ¼". Provide a total width of the primary and secondary seal of ½". Units shall meet IGMA 65-7-2, latest edition. Units shall not contain breather or capillary tubes or similar penetrations.

E. One-Way Mirror Glass: 9/16" laminated, one-way, transparent mirror glass; 1/4" clear, 0.060" PVB interlayer, 1/4" tinted.

    1. Where indicated, provide glass that performs as a mirror on one (subject) side and as transparent glass on the other (observer) side. Glass shall be 1/4", tempered, tinted, with reflective silver-colored coating on the subject side; visible transmittance of 11% and visible reflectance on the coated side of 68%. Coating quality shall meet or exceed ASTM C 1376.

2. Subject to requirements specified, provide product of Pilkington North America, or equivalent product by PPG Industries, Inc., AFG Industries, Inc., or approved equal.

F. Bullet-Resistant Security Glazing

1. Basis-of-Design Product: Subject to compliance with requirements, provide Insulgard Security Products' "BulletBlock HP600."

2. Ballistic Resistance: Level 5, designed to withstand at least one 7.62mm rifle FMJ with a velocity of at least 2750f/s in accordance with UL 752.

3. Glazing: 1/4" clear, tempered Pilkington Energy Advantage Hard Coat Low-E #2 glass + 1/2" air space + 1.28" clear ARMOR-GARD BALULN32 BR LAM, U.L. tested Level 5 with edge seal and BulletBlock HP500 painted full vision door glazed with 1.28" clear ARMOR-GARD BALULN32 BR LAM, U.L. tested Level 5 with edge seal.

4. Maximum Overall Unit Thickness: 1-3/8".

G. Frameless Mirrors: 1/4", Quality q2, clear float glass with silver, copper, and organic coating, edges uniformly ground and polished.

2.3 GLAZING MATERIALS AND PRODUCTS

A. General: Provide sealants and gaskets with performance characteristics suitable for applications indicated. Ensure compatibility of glazing sealants with insulating glass sealants, with laminated glass interlayers, and with any other surfaces in contact.

B. General Glazing and Cap Bead Sealant: Provide sealant with maximum Shore A hardness of 50. Provide one of the following:

1. Dow Corning 795.

2. General Electric Silglaze N 2500 or Contractors SCS-1000.

3. Tremco Spectrem 2.

C. Weather Seal Sealant: Provide non-acid curing sealant with movement range $\pm$ 50%, ASTM C 719. Provide one of the following:

1. Dow Corning 795.

2. General Electric Silpruf.

3. Tremco Spectrem 2.

D. Backer Rod: Closed cell non-gassing polyethylene rod with rod diameter 25% wider than joint width.

E. Dense Elastomeric Compression Seal Gaskets: Provide molded or extruded neoprene or EPDM gaskets, Shore A hardness of 75 ± 5 for hollow profile, and 60 ± 5 for solid profiles, ASTM C 864.

F. Cellular, Elastomeric Preformed Gaskets: Provide extruded or molded closed cell, integral-skinned neoprene, Shore A 40 ± 5, and 20% to 35% compression, ASTM C 509; Type II.

G. Preformed Glazing Tape: Provide solvent-free butyl-polyisobutylene rubber with 100% solids content complying with ASTM C 1281 AAMA A 800 with integral continuous EPDM shim. Provide preformed glazing tape in extruded tape form. Provide Tremco "Polyshim II" or approved equal.

H. Setting Blocks: Provide 100% silicone blocks with Shore A hardness of 80-90. Provide products certified by manufacturer to be compatible with silicone sealants. Length to be not less than 4". Width for setting blocks to be 1/16" more than glass thickness and high enough to provide the lite recommended by glass manufacturer. When thickness of setting block exceeds 3/4" the glass manufacturer must be consulted for sizes and configuration. In a vented system, setting block shall be designed so as to not restrict the flow of water within the glazing rabbet to the weep holes.

1. Shims: For shims used with setting blocks, provide same materials, hardness, length and width as setting blocks.

2. Structural Silicone Glazing: Provide silicone setting blocks where structural silicone occurs at sills and at insulating units with silicone edge seals.

I. Edge Blocks: Provide neoprene or silicone as required for compatibility with glazing sealants. Provide blocks with Shore A hardness of 55$\pm$5.

J. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place.

K. Miscellaneous Glazing Materials: Provide sealant backer rods, primers, cleaners, and sealers of type recommended by glass and sealant manufacturers.

L. Mirror Adhesive: Palmer's "Mirro-Mastic," or approved equal. Mastic must be compatible with mirror backing.

1. Clips: No. 4 finish Type 304 stainless steel.

2.4 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. Grind smooth and polish exposed glass edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine glazing framing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GENERAL GLAZING STANDARDS

A. Install products using the recommendations from the manufacturer of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the GANA "Glazing Manual."

B. Verify that Insulating Glass Unit (IGU) secondary seal is compatible with glazing sealants.

C. Install glass in prepared glazing channels and other framing members.

D. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA's "Glazing Manual" and IGMA's "Glazing Guidelines."

E. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA's "Glazing Manual."

F. Provide weep system as recommended by GANA's "Glazing Manual."

G. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

H. Distribute the weight of glass unit along the edge rather than the corner.

I. Comply with manufacturers and referenced industry standards on expansion joint and anchors; accommodating thermal movement; glass openings; use of setting blocks, edge, face, and bite clearances; use of glass spacers; edge blocks and installation of weep systems.

J. Protect glass edge damage during handling and installation.

K. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

L. Remove and replace glass that is broken, chipped cracked or damaged in any way.

3.4 GLAZING

A. Glazing channel dimensions, as indicated on Shop Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge

damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead. Install setting blocks at the one greater points of each lite along the horizontal mullion.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Flush Glazing

1. If the butt joint in the metal framing is in the vertical direction, the glazier shall run the tape initially on the head and sill members going directly over this joint. Should the butt joint in the metal framing run horizontally, tapes must first be applied to the jambs so that it crosses over the joint.

2. Each tape section shall butt the adjoining tape and be united with a tool to eliminate any opening.

3. Do not overlap the adjoining length of tape or rubber shim as this will prevent full contact around the perimeter of glass.

L. Off-Set Glazing

1. Where the glazing legs are off-set, the difference in the rabbet width shall be compensated by employing different glazing tapes with different diameter shims. The difference in shim

shall be equal to the size of the off-set. The thinner tape shall be positioned first on the glazing leg closest to the interior. The thicker tape shall be cut to the exact length of the dimension between the applied tapes, and installed on the outermost glazing leg.

2. Immediately prior to setting glass, paper backing shall be removed. Apply a toe bead of sealant 6" in each direction, from each corner.

3. Locate setting blocks in the sill member at quarter points, or if necessary to within 6" of each corner. Setting blocks must be set equal distance from center line of the glass and high enough to provide the recommended bite and edge clearances.

4. Set edge block according to glass manufacturer's recommendations.

5. Set Glass: The glass shall be pressed firmly against the tape to achieve full contact.

6. In a vented system, apply a heel bead (air seal) of sealant around the perimeter of glass, between the sole of the I.G. unit and the base of the rabbet of the metal framing developing a positive bond to the unit and to the metal framing. The bead of the sealant shall be deep enough so that it will partially fill the channel to a depth of 1/4" between the glass edge and the base of the metal framing rabbet.

7. Interior stops shall be set, and glazing tape spline for the appropriate face clearance shall be rolled into place, compressing the glass to the shim within the glazing tape.

3.5 GLAZING TAPE

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant as recommended by glass manufacturer or glass frame manufacturer.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape where noted on approved shop drawings.

3.6 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.7 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Exterior glazing gasket shall be set a minimum of 1/8" below exterior glazing stop to create a channel for sealant installation.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.8 FRAMELESS MIRRORS

A. Apply mastic to back of mirror "pats" spaced 4 pats/sq. ft.; adjust mirror so that it is plumb and in place to avoid distortion of reflecting images. Allow 1/8" space between back of mirror and wall surface.

1. Apply "pats" using Palmer Electric Applicator.

B. Apply stainless steel clips at mirror top and bottom; securely clip to substrate using non-corrosive anchors. At drywall back-up anchors must be secured to studs or steel wallplate spanning from stud to stud.

3.9 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Cleaning: Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

1. Glass shall be cleaned according to:

a. GANA Glass Information Bulletin GANA 01-0300 – "Proper Procedure for Cleaning Architectural Glass Products."
b. GANA Glass Informational Bulletin GANA TD-02-0402 – Heat Treated Glass Surfaces are Different."

2. Do not use razor blades, scrapers or metal tools to clean glass.

END OF SECTION

SECTION 089000 - LOUVERS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the louvers as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Aluminum louvers.

2. Blank-off panels.

3. Bird screens.

1.3 RELATED SECTIONS

A. Joint Sealants - Section 079200.

B. Louvers connected to ductwork - Division 23.

1.4 QUALITY ASSURANCE

A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and snow and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter or permanent damage to fasteners and anchors.

1. Wind Load: Comply with Code.

B. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects.

1. Temperature Change (Range): 120 deg. F., ambient; 180 deg. F, material surfaces.

C. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.

D. Field Measurements: Verify size, location, and placement of louver units prior to fabrication.

E. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

F. Louvers shall be tested and certified AMCA 500-L.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, certified test data, where applicable, and installation instructions for required products, including finishes.

B. Shop Drawings: Submit shop drawings for fabrication and erection of louver units and accessories. Include plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery and other information to determine compliance with specified requirements.

C. Samples: Submit six (6) inch square samples of each required finish. Prepare samples on metal of same gauge and alloy to be used in work. Where normal color and texture variations are to be expected, include two (2) or more units in each sample showing limits of such variations.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.7 WARRANTY

A. Finish shall be warranted for a period of 20 years, starting from date of Substantial Completion of the Project.

PART 2 PRODUCTS

2.1 LOUVER MATERIAL

A. Vertical, Wind-Driven-Rain-Resistant, Windborne-Debris-Impact-Resistant Louver, Extruded Aluminum:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Basis of Design:
      1). Pottorff ECV-645-MD
   b. Or Approved Equal.
2. Louver Depth: 6 inches.

3. Frame and Blade Nominal Thickness: Not less than 0.080 inch. Closed frame allowing sealant with back rod installation.

4. Louver Performance Ratings:

   a. Free Area: Not less than 7.4 sq. ft. for 48-inch-wide by 48-inch-high louver.
   b. Air Performance: Not more than 0.15-inch wg static pressure drop at 1250-fpm free-area intake velocity.

c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 965 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

6. AMCA Rating: AMCA 540, AMCA 550.

B. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Color and gloss as selected by the Architect from manufacturer's full range of standard colors.

C. Bird Screens

1. All louvers to be furnished with bird screens, finish to match louvers.

2. Screens to be 5/8" mesh, 0.050" thick expanded and flattened aluminum bird screen secured with 0.055" thick extruded aluminum frames. Frames to have mitered corners and corner locks.

D. Provide aluminum blank-off panels behind louvers where shown on mechanical drawings, fabricated from 1/8" thick aluminum face sheets, finish to match louvers; reinforce as required to form rigid assembly. Blank-off panels shall be insulated with Thermafiber insulation of thickness needed to insure an R value of eleven (11).

E. Fastenings: Fasteners for exterior application shall be stainless steel. Provide types, gauges and lengths to suit unit installation conditions. Use Phillips flat head machine screws for exposed fasteners, unless otherwise indicated.

F. Anchors and Inserts: Use non-ferrous metal or hot dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

G. Bituminous Paint: SSPC-Paint 12 (cold applied asphalt mastic).

2.2 LOUVER FABRICATION, GENERAL

A. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.

B. Include supports, anchorages, and accessories required for complete assembly.

C. Provide sill extensions made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

D. Join frame members to one another and to stationary louver blades by welding, except where indicated otherwise or where field bolted connections between frame members are necessary by size of louvers. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where louvers are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchorages which are to be embedded in masonry construction. Coordinate the delivery of such items to the project site.

3.3 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of the work.

B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designated, fabricated and fitted to the structure.

C. Anchor louvers to the building substructure.

D. Erection Tolerances:

1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding ½" in any total building length or portion thereof (non-cumulative).

2. Maximum offset from true alignment between two members abutting end to end, edge to edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no-load conditions.

E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

F. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

G. Set units level, plumb and true to line, with uniform joints.

3.4 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.5 ADJUSTING AND CLEANING

A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective wok. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials and replace with new materials.

1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION

SECTION 092900 - GYPSUM DRYWALL

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the gypsum drywall as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Gypsum board work for partitions, ceilings, column enclosures, furring, and elsewhere where gypsum drywall work is shown on drawings.
2. Metal supports for gypsum drywall construction.
3. Acoustical insulation for gypsum drywall work.
4. Sealant for gypsum drywall work.
5. Concealed metal reinforcing for attachment of railings, toilet partitions, and other items supported on drywall partitions and walls.
6. Taping and finishing of drywall joints.
7. Installing rings and frames in drywall surfaces for grilles, registers, and lighting fixtures.
8. Gypsum shaft wall construction.
9. Bracing and connections.

1.3 RELATED SECTIONS

A. Thermal Insulation - Section 072100.

B. Hollow metal door frames - Section 081113.

C. Access Doors - Section 083113.

D. Painting and Finishing - Section 099000.

E. Rings for grilles, registers, and light fixtures - Division 23 and 26.

1.4 QUALITY ASSURANCE

A. The following standards, as well as other standards which may be referred to in this Section, shall apply to the work of this Section:

1. The Gypsum Construction Handbook, latest edition, USG.

2. Construction Guide, latest edition, National Gypsum.

3. ASTM A 568 "Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For"

4. ASTM C 475 "Standard Specification for Joint Treatment Materials for Gypsum Wallboard Construction"

5. ASTM C 645 "Standard Specification for Non-Structural Steel Framing Members"

6. ASTM C 754 "Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products"

7. ASTM C 840 "Standard Specification for Application and Finishing of Gypsum Board"

8. ASTM C 919 "Standard Specification for Use of Sealants in Acoustical Applications"

9. ASTM C 954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness"

10. ASTM C 1002 "Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Board"

11. ASTM C 1177 "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing"

12. ASTM C 1178 "Standard Specification for Glass Mat Water Resistant Gypsum Backing Board"

13. ASTM C 1278 "Standard Specification for Fiber-Reinforced Gypsum Panel"

14. ASTM C 1396 "Standard Specification for Gypsum Board"

15. ASTM D 3273 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber"

B. Allowable Tolerances: 1/32" offsets between planes of board faces, and 1/16" in 8'-0" for plumb, level, warp and bow.

C. System Design Load

1. Provide standard drywall wall assemblies designed and tested by manufacturer to withstand a lateral load of 5 lbs. per sq. ft. for the maximum wall height required, and with deflection limited to L/240 of partition height.

   a. Drywall assemblies with tile finish shall have a deflection limit of L/360.

2. Provide drywall ceiling assemblies designed, fabricated, and installed to have a deflection not to exceed L/360.

D. Fire-Resistance Rating: Where gypsum drywall with fire resistance ratings are indicated, provide materials and installations which are identical with those of applicable assemblies tested per ASTM E 119 by fire testing laboratories, or to design designations in UL "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction,

and compliant with UL Test #2079; criteria for cycle movement for all field height wall sections requiring allowance for vertical deflection within framing details.

E. Installer: Firm with not less than 5 years of successful experience in the installation of specified materials.

F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.

1.5 SUBMITTALS

A. Submit shop drawing for each drywall partition, furring and ceiling system showing size and gauges of framing members, hanger and anchorage devices, wallboard types, insulation, sealant, methods of assembly and fastening, control joints indicating column lines, corner details, joint finishing and relationship of drywall work to adjacent work.

B. Samples: Each material specified herein, 12" x 12", or 12" long, or in manufacturer's container, as applicable for type of material submitted.

C. Manufacturer's Literature: Submit technical and installation instructions for each drywall partition, furring and ceiling system specified herein, and for each fire-rated and sound-rated gypsum board assembly. Submit other data as required to show compliance with these specifications, including data for mold resistant joint compound.

D. Test Reports: This Contractor shall submit test report, obtained by drywall manufacturer, indicating conformance of drywall assemblies to required fire ratings and sound ratings.

E. Evaluation Reports: Submit evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

1.6 PRODUCT HANDLING AND PROTECTION

A. Deliver, store and handle drywall work materials to prevent damage. Deliver materials in their original, unopened containers or bundles, and store where protected from moisture, damage and from exposure to the elements. Store wallboard in flat stacks.

B. Protect wallboard from becoming wet.

C. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice."

1.7 ENVIRONMENTAL CONDITIONS

A. Provide and maintain minimum temperature of fifty-five (55) degrees F. and adequate ventilation to eliminate excessive moisture within the building in the area of the drywall work for at least twenty-four (24) hours, prior to, during and after installation of drywall work. Installation shall not start until windows are glazed and doors are installed, unless openings are temporarily closed. Space above suspended ceilings shall be vented sufficiently to prevent temperature and pressure build up.

1.8 JOB MOCK-UP

A. At a suitable location, where directed by the Architect, lay up a portion of a finished wall and ceiling demonstrating the quality of work, including finishing, to be obtained under this Section. Omit drywall boards in locations as directed by the Architect to show stud spacing and attachments; after acceptance, complete assembly.

B. Adjust the finishing techniques as required to achieve the finish required by the Architect as described in this Section of these specifications.

C. Upon approval of the mock-up, the mock-up may be left in place as a portion of the finished work of this Section.

D. All drywall work shall be equal in quality to approved mock-up.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers for Gypsum Drywall Panels and Accessories: U.S. Gypsum Co., Georgia Pacific, CertainTeed Corporation, Continental Building Products, or National Gypsum Co. meeting specification requirements are acceptable.

1. All drywall products must be manufactured in North America.

B. Acceptable Manufacturers for Metal Supports of Drywall Assemblies: Unless otherwise noted, provide products manufactured by ClarkDietrich, Super Stud Building Products, Marino/Ware, or approved equal.

2.2 METAL SUPPORTS

A. Metal Floor and Ceiling Runners

1. Drywall Track: Formed from 0.0312 inch (20 U.S. Std. gauge) (minimum unless otherwise noted or required by performance requirements) cold formed steel, width to suit shaped metal studs. Use 20 ga. top runners with 1-1/4" minimum flanges.

2. Deflection track or head of wall connections at rated partitions shall conform to UL #2079 for cycle movement. Provide positive mechanical connection of framing to structure, allowing for vertical movement within connections. Minimum of 0.0312 (20 ga.) cold formed steel for clips, 25 ga. cold formed steel for deflection track.

a. Product: "BlazeFrame DSL" or "MaxTrak Slotted Deflection Track" as manufactured by ClarkDietrich, "VertiClip" or "VertiTrack" as manufactured by the Steel Network or equal made by Metal-Lite Inc.
b. FireTrak (including stud clips) by FireTrak Corp. or equal made by Metal-Lite Inc.

3. Shaft Wall "J" Type Runner: Formed from 0.0329" (20 U.S. Std. gauge) galvanized steel, 1" x 2-1/2" or 4" wide (to suit detail) x 2-1/4" (for shaft wall).

B. Metal Studs, Framing and Furring

1. C-Shaped Studs: Channel type with holes for passage of conduit formed from minimum 0.0312" (20 U.S. Std. gauge) (unless heavier gauge is required to meet deflection limits) cold formed steel, width as shown on drawings.

2. Furring Channels: Hat shaped, formed from galvanized steel, 25 U.S. Std. gauge.

   a. Product: ClarkDietrich; Furring Channel, or a comparable product.

3. "C-H," "CT," or "I" Type Stud: 1-1/2" x 2-1/2", 4" or 6" wide (to suit detail) galvanized steel. Use for shaft wall construction; gauge and size as required to meet deflection limits given herein.

   a. Product: ClarkDietrich; CT Stud, or a comparable product.

4. Double "E" Type Stud or "J" Track with Holding Tabs: 1" x 2-1/2", 4" or 6" wide (to suit detail) galvanized steel. Use for shaft wall construction; gauge and size as required to meet deflection limits given herein.

   a. Product: ClarkDietrich; J-Ribbed Track, or a comparable product.

5. Continuous 16 gauge x 8" wide steel wall plate screwed to studs as required for support of railings, toilet partitions, and other items supported on drywall partitions and walls.

C. Suspended Ceiling and Fascia Supports

1. Main Runners: 1-1/2" steel channels, cold rolled at 0.475 lbs. per ft., rust-inhibitive paint finish.

2. Furring Members: Screw-type hat-shaped furring channels of 25 ga. zinc-coated steel; comply with ASTM C 645.

3. Hangers: Galvanized, 1" x 3/16" flat steel slats capable of supporting 5x calculated load supported.

4. Hanger Anchorages: Provide inserts, clips, bolts, screws, and other devices applicable to the required method of structural anchorage for ceiling hangers. Size devices for 5x calculated load supported.

5. Furring Anchorages: 16 ga. galvanized wire ties, manufacturer's standard clips, bolts or screws as recommended by furring manufacturer.

D. Protective Coating: All cold-formed steel members shall have coating conforming to AISI S220; ASTM A 653, G60 or coating with equivalent corrosion resistance of ASTM A653/A653M, G60. Galvannealed products are not acceptable.

2.3 GYPSUM WALLBOARD TYPES

A. Gypsum Wallboard: 5/8" thick "Sheetrock" by USG, "Gold Bond" by National Gypsum, or "Regular Gypsum" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

B. Gypsum Ceiling Board: 5/8" thick, sag-resistant, long edges tapered.

C. Fire-Rated Gypsum Wallboard: 5/8" thick "Sheetrock Firecode C" by USG, "Firecheck Type C" by Lafarge/Continental, "Gold Bond Fireshield" by National Gypsum, or "Type C" and "Type X" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

D. Water-Resistant Backing Board for Tile Finish: 1/2" thick, "DUROCK Glass Mat Tile Backerboard" by USG, "Dens-Shield Tile Backer Board" by Georgia Pacific or "DiamondBack Tile Backer" by CertainTeed Corp. Cover joints with a pressure sensitive woven glass fiber tape equal to Imperial Type P Tape.

E. Mold-Resistant Paperless Gypsum Wallboard: 5/8" thick, 48" wide "DensArmour Plus" and "DensArmour Plus Fireguard C" by Georgia Pacific, or equal by National Gypsum, USG or approved equal that has a rating of 10 per ASTM D 3273 with core that meets ASTM C 1396, Section 6 or ASTM C 1658.

F. Moisture/Mold-Resistant Gypsum Wallboard (at all exterior walls and wet areas): 5/8" thick "Mold Tough," "Mold Tough FR," by U.S. Gypsum, "DensArmor Plus" by Georgia Pacific, "Mold Defense" and/or "Mold Defense Type X" by Lafarge/Continental, or "Gold Bond EXP Interior Extreme Gypsum Board" by National Gypsum, 48" wide, in maximum lengths available to minimize end-to-end butt joints.

1. Board must have a rating of 10 per ASTM D 3273 with a core that meets ASTM C 1396, Section 6, or ASTM C 1658.

G. Mold-Resistant Shaft Wall Liner: Solid gypsum board liner for shaft wall construction, 1" thick, 24" wide, as required to suit condition, by standard lengths as required, beveled edges. Provide "Mold Tough Liner Panel" by USG, "DensGlass Shaftliner" by Georgia Pacific, "Mold Defense Shaftliner Type X" and/or "Weather Defense Shaftliner Type X" by Lafarge/Continental, "Gold Bond Brand Fireshield Shaft Liner XP" or "Gold Bond Brand EXP Extended Exposure Shaft Liner" by National Gypsum, or "M2Tech Shaftliner" by CertainTeed Corp.

1. Liner board must have a rating 10 per ASTM D 3273 with a core that meets ASTM C 1396 Section 6.

H. Abuse-Resistant Wallboard: 5/8" thick "Sheetrock Brand Mold Tough AR" by USG, "Dens Armor Plus Abuse Resistant Panels" by Georgia-Pacific, "EXP Interior Extreme AR" or "Gold Bond Brand Hi-Abuse XP" by National Gypsum, "Protecta AR100" or "Protecta HIR 300" by Lafarge/Continental, or "AirRenew Extreme Abuse" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

1. Board must achieve a Level 1 rating per ASTM C 1629.

I. Impact-Resistant Wallboard: 5/8" thick "Sheetrock Brand Mold Tough VHI" by USG, "DensArmor Plus Impact-Resistant Panels" by Georgia-Pacific, "EXP Interior Extreme IR" or "Gold Bond Brand Hi-Impact XP" by National Gypsum, "Protecta HIR 300" by Lafarge/Continental, or "AirRenew Extreme Impact" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

J. Sound Dampening Gypsum Board: Provide 5/8" thick "Gold Bond SoundBreak XP Wall Board" as manufactured by National Gypsum, with tapered edges, STC of 48-60 per ASTM E 90, and conforming to ASTM C 1396 and ASTM C 1766. Multilayer product constructed of two layers of high-density, mold, moisture, and mildew resistant gypsum board laminated together with a sound dampening viscoelastic polymer center sandwiching a Type X core.

2.4 ACCESSORIES

A. Acoustical Insulation: Paper-less, non-combustible, semi-rigid mineral fiber mat, 2" thick, in walls (unless otherwise indicated), 3 lb./cu. ft. maximum density; Thermafiber "Thermafiber SAFB," Rockwool "Rockwool AFB" or approved equal.

B. Fasteners for Wallboard: USG Brand Screws; Type S Bugle Head for fastening wallboard to lighter gauge interior metal framing (up to 20 ga.). Type S-12 Bugle Head for fastening wallboard to heavier gauge interior metal framing (20 ga. to 12 ga.); Type S and Type S-12 Pan Head for attaching metal studs to door frames and runners; and Type G Bugle Head for fastening wallboard to wallboard. Lengths specified below under "Part 3 - Execution" Articles and as recommended by drywall manufacturer.

1. For Portland cement base boards, fasteners shall be equal to Durock Steel Screws by U.S. Gypsum.

C. Laminating Adhesive: "Sheetrock Brand Joint Compound."

D. Metal Trim - Corner Beads: For 90 degree external corners, provide ClarkDietrich "103 Deluxe Corner Bead (CBU)" or "103 Dur-A-Bead" by USG, 26 U.S. Std. ga. galvanized steel, 1-1/4" x 1-1/4".

E. Metal Trim - Edge Beads: "Sheetrock Brand Paper Faced Metal Bead and Trim."

F. Partition/Concrete Ceiling Trim: Trim-Tex Super Seal Tear Away or approved equal.

G. Metal Trim Treatment Materials and Joint Treatment Materials for Gypsum Drywall Boards: Paper tape for joint reinforcing; Setting Type (Durabond 90) or Lightweight Setting Type Joint Compound for taping and topping; and Ready Mix Compound for finishing.

1. For mold-resistant drywall, water-resistant drywall, and tile backer board, use glass mesh tape with setting joint compound that is rated 10 when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Acceptable joint compound is "Rapid Set One Pass" made by CTS Cement Manufacturing Corp. or "Rapid Joint" manufactured by Lafarge North America or approved equal meeting standards noted herein.

H. Control Joints: ClarkDietrich; #093 Control Joint or No. 0.093 by USG.

I. Acoustical Sealant: USG "Acoustical Sealant," Tremco Mfg. Co. "Tremco Acoustical Caulking," BASF "MasterSeal NP520," or approved equal.

J. Neoprene Gaskets: Conform to ASTM D 1056.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where gypsum drywall is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. General

1. Install drywall work in accordance with drywall manufacturer's printed instructions and as indicated on drawings and specified herein.

2. All metal framing for drywall partitions shall extend from floor to underside of structural deck above. Provide for vertical deflection with positive mechanical connections of framing members to structure.

3. Provide concealed reinforcement, 16 ga. thick by eight (8) inches wide or as detailed or as recommended by manufacturer, for attachment of railings, toilet partitions, and other items to be supported on the partitions which cannot be attached to the metal framing members. Concealed reinforcement shall span between metal studs and be attached thereto using two (2) self-tapping pan head screws at each stud.

   a. Back of drywall shall be scored or notched to prevent bulging out where reinforcement plate occurs.

B. Fire-Rated Assemblies: Install fire-rated assemblies in accordance with requirements of authorities having jurisdiction, Underwriters' Laboratories and test results obtained and published by the drywall manufacturer, for the fire-rated drywall assembly types indicated on the drawings.

C. Acoustical Assemblies: Install acoustically-rated assemblies to achieve a minimum STC as noted on drawings, in accordance with test results obtained and published by the drywall manufacturer, for the drywall assembly type indicated on the drawings.

D. Sealant

1. Install continuous acoustical sealant bead at top and bottom edges of wallboard where indicated or required for sound rating as wallboard is installed, and between metal trim edge beads and abutting construction.

2. Install acoustical sealant in 1/8" wide vertical control joints within the length of the wall or partitions, and in all other joints, specified below under "Control Joints." Install bead of acoustical sealant around electric switch and outlet boxes, piping, ducts, and around any other penetration in the wallboard; place sealant bead between penetrations and edge of wallboard.

3. Where sealant is exposed to view, protect adjacent surfaces from damage and from sealant material, and tool sealant flush with and in same plane as wallboard surface. Sealant beads shall be 1/4" to 3/8" diameter.

E. Wallboard Application

1. Do not install wallboard panels until steel door frames are in place; coordinate work with Section 081113, "Steel Doors and Frames."

2. See drawings for all board types. Use fire-rated wallboard for fire-rated assemblies. Use sag-resistant board for ceilings. Use water-resistant wallboard where indicated on

drawings and where wallboard would be subject to moisture. Install water-resistant wallboard in full, large sheets (no scraps) to limit number of butt joints.

3. Apply wallboard with long dimension parallel to stud framing members, and with abutting edges occurring over stud flanges.

4. Install wallboard for partitions from floor to underside of structure above and secure rigidly in place by screw attachment, unless otherwise indicated.

5. Provide "Thermafiber" safing insulation meeting standards of Section 078413 at flutes of metal deck where partitions carry up to bottom of metal deck.

6. Neatly cut wallboard to fit around outlets, switch boxes, framed openings, piping, ducts, and other items which penetrate wallboard; fill gaps with acoustic sealant.

7. Screw fasten wallboard with power-driven electric screwdriver, screw heads to slightly depress surface of wallboard without cutting paper, screws not closer than 3/8" from ends and edges of wallboard.

8. Where studs are doubled-up, screw fasten wallboard to both studs in a staggered pattern.

F. Cementitious Backer Board

1. General: Furnish cementitious backer board in maximum available lengths. Install horizontally, with end joints over framing members.

2. Fastening: Secure cementitious backer board to each framing member with screws spaced not more than 12 inches on center and not closer than 1/2" from the edge. Install screws with a conventional screw gun so that the screw heads are flush with the surface of the board.

3. Joint Treatment: Fill space between edge of backer and receptor with dry-set Portland cement or latex-Portland cement mortar. Fill all horizontal and vertical joints and corners with dry-set Portland cement or latex-Portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.

G. Metal Trim: Install and mechanically secure in accordance with manufacturer's instructions; and finish with three (3) coats of joint compound, feathered and finish sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions.

1. Corner Beads: Install specified corner beads in single lengths at all external corners, unless corner lengths exceed standard stock lengths.

2. Edge Beads: Install specified edge beads in single lengths at all terminating edges of wallboard exposed to view, where edges abut dissimilar materials, where edges would be exposed to view, and elsewhere where shown on drawings. Where indicated on drawings, seal joint between metal edge bead and adjoining surface with specified gasket, 1/8" wide minimum and set back 1/8" from face of wallboard, unless other size and profile indicated on drawings.

3. Casing beads shall be set in long lengths, neatly butted at joints. Provide casing beads at juncture of board and vertical surfaces and at exposed perimeters.

H. Control Joint Locations: Gypsum board surfaces shall be isolated with control joints where:

1. Ceiling abuts a structural element, dissimilar wall or other vertical penetration.

2. Construction changes within the plane of the partition or ceiling.

3. Shown on approved shop drawings.

4. Ceiling dimensions exceed thirty (30) feet in either direction.

5. Wings of "L," "U," and "T" shaped ceiling areas are joined.

6. Expansion or control joints occur in the structural elements of the building.

7. Shaft wall runs exceed 30' without interruption.

8. Partition or furring abuts a structural element or dissimilar wall or ceiling.

9. Partition or furring runs exceed 30' without interruption.

10. Where control joints are required, ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners.

I. Joint Treatment and Spackling

1. Joints between face wallboards in the same plane, joints at internal corners of intersecting partitions and joints at internal corners of intersections between ceilings and walls or partitions shall be filled with joint compound.

2. Screw heads and other depressions shall be filled with joint compound. Joint compound shall be applied in three (3) coats, feathered and finish surface sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions. Treatment of joints and screw heads with joint compound is also required where wallboard will be covered by finish materials which require a smooth surface, such as vinyl wall coverings.

3.3 FURRED WALLS AND PARTITIONS

A. Use specified metal furring channels. Run metal furring channel framing members vertically, space sixteen (16) inches o.c. maximum. Fasten furring channels to concrete or masonry surfaces with power-driven fasteners or concrete stub nails spaced sixteen (16) inches o.c. maximum through alternate wing flanges (staggered) of furring channel. Furring channels shall be shimmed as necessary to provide a plumb and level backing for wallboard. At inside of exterior walls, an asphalt felt protection strip shall be installed between each furring channel and the wall. Furring channel and splices shall be provided by nesting channels at least eight (8) inches and securely anchoring to concrete or masonry with two (2) fasteners in each wing.

B. Wallboard Installation: Same as specified under Article 3.4 - "Metal Stud Partitions."

3.4 METAL STUD PARTITIONS

A. Unless otherwise noted, steel framing members shall be installed in accordance with ASTM C 754.

B. Runner Installation: Use channel type. Align accurately at floor according to partition layout. Anchor runners securely sixteen (16) inches o.c. maximum with power-driven anchors to floor

slab, with power-driven anchors to structural slab above. See "Stud Installation" below for runners over heads of metal door frames. Where required, carefully remove sprayed-on fireproofing to allow partition to be properly installed.

C. Stud Installation

1. Use channel type, positioned vertically in runners, spaced as noted on drawings, but not more than sixteen (16) inches o.c.

2. Anchor studs to floor runners with screw fasteners. Provide snap-in or slotted hole slip joint bolt connections of studs to ceiling runners leaving space for movement. Anchor studs at partition intersections, partition corners and where partition abuts other construction to floor and ceiling runners with sheet metal screws through each stud flange and runner flange.

3. Connection at ceiling runner for non-rated partitions shall be snap-in or slotted hole slip joint bolt connection that shall allow for movement. Seal studs abutting other construction with 1/8" thick neoprene gasket continuously between stud and abutting construction.

4. Connections for fire rated partitions at ceiling runners shall conform to UL Design #2079.

5. Install metal stud horizontal bracing wherever vertical studs are cut or wallboard is cut for passage of pipes, ducts or other penetrations, and anchor horizontal bracing to vertical studs with sheet metal screws.

6. At jambs of door frames and borrowed light frames, install doubled-up studs (not back to back) from floor to underside of structural deck, and securely anchor studs to jamb anchors of frames and to runners with screws. Provide cross braces from hollow metal frames to underside of slab.

7. Over heads of door frames, install cut-to-length section of runner with flanges slit and web bent to allow flanges to overlap adjacent vertical studs, and securely anchor runner to adjacent vertical studs with sheet metal screws. Install cut-to-length vertical studs from runner (over heads of door frame) to ceiling runner sixteen (16) inches maximum o.c. and at vertical joints of wallboard, and securely anchor studs to runners with sheet metal screws.

8. At control joints, in field of partition, install double-up studs (back to back) from floor to ceiling runner, with 1/4" thick continuous compressible gasket between studs. When necessary, splice studs with eight (8) inches minimum nested laps and attach flanges together with two (2) sheet metal screws in each flange. All screws shall be self-tapping sheet metal screws.

D. Runners and Studs at Chase Wall: As specified above for "Runners" and "Studs" and as specified herein. Chase walls shall have either a single or double row of floor and ceiling runners with metal studs sixteen (16) inches o.c. maximum and positioned vertically in the runners so that the studs are opposite each other in pairs with the flanges pointing in the same direction. Anchor all studs to runner flanges with sheet metal screws through each stud flange and runner flange following requirements of paragraph 3.4, B. Provide cross bracing between the rows of studs by attaching runner channels or studs set full width of chase attached to vertical studs with one self-tapping screw at each end. Space cross bracing not over thirty-six (36) inches o.c. vertically.

E. Wallboard Installation - Single Layer Application (Screw Attached)

1. Install wallboard with long dimension parallel to framing member and with abutting edge joints over web of framing member. Install wallboard with long dimension perpendicular to framing members above and below openings in drywall extending to second stud at each side of opening. Joints on opposite sides of wall shall be arranged so as to occur on different studs.

2. Boards shall be fastened securely to metal studs with screws as specified. Where a free end occurs between studs, back blocking shall be required. Center abutting ends over studs. Correct work as necessary so that faces of boards are flush, smooth, true.

3. Wallboard screws shall be applied with an electric screw gun. Screws shall be driven not less than 3/8" from ends or edges of board to provide uniform dimple not over 1/32" deep. Screws shall be spaced twelve (12) inches o.c. in the field of the board and 8" o.c. staggered along the abutting edges.

4. All ends and edges of wallboard shall occur over screwing members (studs or furring channels). Boards shall be brought into contact but shall not be forced into place. Where ends or edges abut, they shall be staggered. Joints on opposite sides of a partition shall be so arranged as to occur on different studs.

5. At locations where piping receptacles, conduit, switches, etc., penetrate drywall partitions, provide non-drying sealant and an approved sealant stop at cut board locations inside partition.

F. Wallboard Installation - Double-Layer Application

1. General: See drawings for wallboard partition types required.

2. First Layer (Screw Attached): Install as described above for single layer application.

3. Second Layer (Screw Attached): Screw attach second layer, unless laminating method of attachment indicated on drawings or necessary to obtain required sound rating or fire rating. Install wallboard vertically with vertical joints offset thirty-two (32) inches from first layer joints and staggered on opposite sides of wall. Attach wallboard with 1-5/8" screws sixteen (16) inches o.c. along vertical joints and sixteen (16) inches o.c. in the field of the wallboard. Screw through first layer into metal framing members.

4. Second Layer (Laminated): Install wallboard vertically. Stagger joints of second layer from first layer joints. Laminate second layer with specified laminating adhesive in beads or strips running continuously from floor to ceiling in accordance with manufacturer's instructions. After laminating, screw wallboard to framing members with 1-5/8" screws, spaced twelve (12) inches o.c. around perimeter of wallboard.

G. Wallboard Installation - Laminated Application: Where laminated wallboard is indicated, use specified laminating adhesive, install wallboard vertically and maintain tolerances as specified for screw attached wallboard.

H. Insulation Installation: Install where indicated on drawings. Place blanket tightly between studs.

I. Deflection of Structure Above: To allow for possible deflection of structure above partitions, provide top runners for non-rated partitions with 1-1/4" minimum flanges and do not screw studs or drywall to top runner. Where positive anchorage of studs to top runner is required, anchorage device shall be by means of slotted hole (in clip connection with screw attachment to web of steel through bushings located in slots of clips), or other anchorage device approved by Architect.

J. Control Joints

1. Leave a 1/2" continuous opening between gypsum boards for insertion of surface mounted joint.

2. Back by double framing members.

3. Attach control joint to face layer with 9/16" galvanized staples six (6) inches o.c. at both flanges along entire length of joint.

4. Provide two (2) inch wide gypsum panel strip or other adequate seal behind control joint in fire rated partitions and partitions with safing insulation.

3.5 DRYWALL FASCIAS AND CEILINGS

A. Furnish and install inserts, hanger clips and similar devices in coordination with other work.

B. Secure hangers to inserts and clips. Clamp or bolt hangers to main runners.

C. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. along runners, except as otherwise shown.

D. Level main runners to a tolerance of 1/4" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.

E. Metal Furring Channels: Space sixteen (16) inches o.c. maximum. Attach to 1-1/2" main runner channels with furring channel clips (on alternate sides of main runner channels). Furring channels shall not be let into or come in contact with abutting masonry walls. End splices shall be provided by nesting furring channels no less than eight (8) inches and securely wire tying. At any openings that interrupt the furring channels, install additional cross reinforcing to restore lateral stability.

F. Mechanical accessories, hangers, splices, runner channels and other members used in suspension system shall be of metal, zinc coated, or coated with rust inhibitive paint, of suitable design and of adequate strength to support units securely without sagging, and such as to bring unit faces to finished indicated lines and levels.

1. Provide special furring where ducts are over two (2) feet wide.

G. Apply board with its long dimension at right angles to channels. Locate board butt joints over center of furring channels. Attach board with one (1) inch self-drilling drywall screws twelve (12) inches o.c. in field of board at each furring channel; eight (8) inches o.c. at butt joints located not less than 3/8" from edges.

3.6 SHAFT WALLS

A. Runner Installation: Use "J" metal runners at floor and ceiling, with the short leg toward finish side of wall. Securely attach runners to structural supports with power-driven fasteners at both ends and twenty-four (24) inches o.c.

B. Shaft Wall Liner: Cut shaft wall liner panels one (1) inch less from floor to ceiling height and erect vertically between J-runners.

C. C-H Studs: Cut metal studs 3/8" to not more than 1/2" less than floor to ceiling height and install between shaft wall liner panels so that panels are fitted snugly into the one (1) inch wide "H," "T," or "I" portion of the stud. Space studs twenty-four (24) inches o.c., unless otherwise indicated on drawings. Install full-length steel E-Studs or J-runners vertically at T-intersections, corners, door jambs, and columns. Install full length E-Studs or J-runners over shaft wall liner both sides of closure panels. Frame openings cut within a liner panel with J-Runner around perimeter. For openings, frame with vertical E-Stud or J-runner at edges, horizontal runner at head and sill, and reinforcing as shown on the drawings. Suitably frame all openings to maintain structural support for wall. Over metal doors, install a cut to length section of runner and attach to strut-studs with clip angles and 3/8" Type S Screws space twelve (12) inches o.c.

D. Wallboard Installation - Double Layer Installation: Erect gypsum wallboard base layer vertically or horizontally to meet fire rating on one side of studs with end joints staggered. Fasten base layer panels to studs with one (1) inch Type S screws twenty-four (24) inches o.c. Caulk perimeter of base layer panels. Apply gypsum wallboard face layer vertically over base layer with joints staggered and attached with 1-5/8" Type S screws staggered from those in base, spaced eight (8) inches o.c. and driven into studs.

E. Wallboard Installation (Where Both Sides of Shaft Wall are Finished): Apply gypsum wallboard face layers vertically both sides of studs. Stagger joints on opposite partition sides. Fasten panels with one (1) inch or two (2) inches Type S screws spaced eight (8) inches o.c. in field and along edges into studs.

F. Where handrails are indicated for direct attachment to drywall shaft system, provide not less than a sixteen (16) ga. x eight (8) inches wide galvanized steel reinforcement strip, accurately positioned and secured to studs and concealed behind not less than one 1/2" thick course of gypsum board in the system.

G. Integrate stair hanger rods with drywall shaft system by locating cavity of system as required to enclose rods.

3.7 ERECTION AT COLUMN ENCLOSURES

A. Metal furring supports shall be provided under work of this Section, and shall be cut to lengths as necessary for tight fit such that spacing is not more than sixteen (16) inches o.c.

B. Board shall be fastened securely to supports with screws as specified. Place boards in position with minimum number of joints. Where free ends occur between supports, back-blocking or furring shall be required. Center abutting ends over supports. Correct work as necessary so that faces of boards are flush, smooth and true. Provide clips or cross furring for attachment as required.

C. All layers shall be screw attached to furring.

D. When column finish called for on drawings to be in the same plane as drywall finish layer, maintain even, level plane.

3.8 FINISHING

A. Taping: A thin, uniform layer of compound shall be applied to all joints and angles to be reinforced. Reinforcing tape shall be applied immediately, centered over the joint, seated into the compound. A skim coat shall follow immediately but shall not function as a fill or second coat. Tape shall be properly folded and embedded in all angles to provide a true angle.

B. Filling: After initial coat of compound has hardened, additional compound shall be applied, filling the board taper flush with the surface. The fill coat shall cover the tape and feather out slightly beyond the tape. On joints with no taper, the fill coat shall cover the tape and feather out at least four (4) inches on either side of the tape. No fill coat is necessary on interior angles.

C. After compound has hardened, a finishing coat of compound shall be spread evenly over and extending slightly beyond the fill coat on all joints and feathered to a smooth, uniform finish. Over tapered edges, the finished joint shall not protrude beyond the plane of the surface. All taped angles shall receive a finish coat to cover the tape and taping compound and provide a true angle. Where necessary, sanding shall be done between coats and following the final application of compound to provide a smooth surface, ready for painting.

D. Fastener Depressions: Compound shall be applied to all fastener depressions followed, when hardened by at least two (2) coats of compound, leaving all depressions level with the plane of the surface.

E. Finishing Beads and Trim: Compound shall be applied to all bead and trim and shall be feathered out from the ground to the plane of the surface. When hardened, this shall be followed by two (2) coats of compound each extending slightly beyond the previous coat. The finish coat shall be feathered from the ground to the plane of the surface and sanded as necessary to provide a flat, smooth surface ready for decoration.

F. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840 and GA-214 of the Gypsum Association.

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are a substrate for tile, and where indicated.

3. Level 5: Level of finish for surfaces exposed to view shall conform to Level 4.

G. Drywall construction with defects of such character which will mar appearance of finished work, or which is otherwise defective, will be rejected and shall be removed and replaced at no expense to the Owner.

3.9 CLEANING AND ADJUSTMENT

A. At the completion of installation of the work, all rubbish shall be removed from the building leaving floors broom clean. Excess material, scaffolding, tools and other equipment shall be removed from the building.

B. Work shall be left in clean condition ready for painting or wall covering. All work shall be as approved by Architect.

C. Cutting and Repairing: Include all cutting, fitting and repairing of the work included herein in connection with all mechanical trades and all other trades which come in conjunction with any part of the work and leave all work complete and perfect after all trades have completed their work.

3.10 PROTECTION OF WORK

A. Installer shall advise Contractor of required procedures for protecting drywall work from damage and deterioration during remainder of construction period.

END OF SECTION

SECTION 093013 - CERAMIC TILING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the ceramic tiling work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Ceramic floor tile.
2. Ceramic wall tile and base.
3. Stone saddles.
4. Setting beds, grout, and sealant.
5. Waterproofing membrane.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Gypsum Drywall - Section 092900.

1.4 REFERENCES

A. ANSI A108 Series/A118 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A136.1 - American National Standards for Organic Adhesives for Installation of Ceramic Tile.

C. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

D. ASTM C 150 - Standard Specification for Portland Cement.

E. TCNA - Handbook for Ceramic, Glass and Stone Tile Installation; Tile Council of North America.

F. ISO 13007 - International Standards Organization; Classification for Grout and Adhesives.

G. Large Format Tile (LFT): Tile 15" or larger in any direction and/or 144 sq. in. in size.

1.5 QUALITY ASSURANCE

A. Qualifications of Installers: For cutting, installing and grouting of ceramic tile, use only thoroughly trained and experienced journeyman tile setters who are completely familiar with

the requirements of this work, and the recommendations contained in the referenced standards, and the installers are Certified Ceramic Tile Installer (CTI) through the Ceramic Tile Education Foundation (CTEF) or Tile Installer Thin Set Standards (ITS) verification through the University of Ceramic Tile and Stone.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the following:

1. Manufacture all ceramic tile in accordance with Standard Grade Requirements of ANSI A-137.1.

2. Install all ceramic tile in accordance with the recommendations contained in "Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation (TCNA)," latest edition.

C. Flooring surfaces shall have a minimum wet DCOF AcuTest value of 0.42 and tested per ANSI A326.3 Dynamic Coefficient of Friction of Hard Surface Flooring Materials.

1.6 SUBMITTALS

A. Samples

1. Before any ceramic tile is delivered to the job site, submit to the Architect sample panels, approx. 12" x 12", mounted on hardboard back-up with selected grout color for each color and pattern of ceramic tile and grout specified.

2. Submit 6" length of stone saddles.

3. Submit 12" x 12" samples of waterproofing membrane.

B. Master Grade Certificates: Prior to opening ceramic tile containers, submit to the Architect a Master Grade Certificate, signed by an officer of the firm manufacturing the ceramic tile used, and issued when the shipment is made, stating the grade, kind of tile, identification marks for tile containers, and the name and location of the project.

C. Mock-Ups

1. At an area on the site where approved by the Architect, provide a mock-up ceramic tile installation.

   a. Make the mock-up approximately 36" x 36" in dimension.
   b. Provide one mock-up for each type, class, and color of installation required under this Section.
   c. The mock-ups may be used as part of the Work and may be included in the finished Work when so approved by the Architect.
   d. Revise as necessary to secure the Architect's approval.

2. The mock-ups, when approved by the Architect, will be used as datum for comparison with the remainder of the work of this Section for the purposes of acceptance or rejection.

3. If the mock-up panels are not permitted to be part of the finished Work, completely demolish and remove them from the job site upon completion and acceptance of the work of this Section.

1.7 PRODUCT HANDLING

A. Delivery and Storage

1. Deliver all materials of this Section to the job site in their original unopened containers with all labels intact and legible at time of use.

2. Store all materials under cover in a manner to prevent damage and contamination; store only the specified materials at the job site.

B. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 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 not less than 50 deg. F. in tiled areas during installation and for 7 days after completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2. Obtain waterproof/crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.

2. Waterproof membrane.

3. Metal edge strips.

2.2 MANUFACTURERS OF TILE

A. Provide tile as scheduled on the drawings or approved equal meeting these specifications. The Architect reserves the right to pick tile from any price group.

2.3 WALL TILE AND BASE

A. Provide vitreous, cushion edge units, 4-1/4" x 4-1/4" x 1/4" thick, matte glazed, in colors as selected by the Architect.

B. Provide sanitary cove base to match wall tile.

2.4 FLOOR TILE

A. Provide porcelain type ceramic floor tile with all-purpose edge in size, color and pattern as selected by the Architect. Tile to have water absorption not to exceed 0.5%.

B. Provide non-slip tile where scheduled, of same characteristics as ceramic tile specified herein with the addition of 7-1/2% abrasive grain by weight.

2.5 TRIM AND SPECIAL SHAPES

A. Provide external and internal corners, trim shapes at openings, and all other trim and special shapes to match the tile specified herein, as required by field conditions and drawing details.

2.6 STONE SADDLES

A. Provide sound Group "A" white marble, minimum 3/4" thick, with an abrasive hardness of not less than 10.0, when tested in accordance with ASTM C 241. Cut saddle to fit jamb profile, honed finish.

2.7 SETTING BEDS AND GROUT

A. Portland Cement: ASTM C 150, Type 1.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144, clean and graded natural sand.

D. Reinforcing for Mud Set Systems: 2" x 2" x 16/16 ga. welded wire mesh.

E. Latex Modified Mortar Bed

1. Laticrete 3701 Fortified Mortar Bed.

2. MAPEI, Modified Mortar Bed.

3. Pro Spec, Floor Mud with B-710 SBR Acrylic Additive.

F. Latex-Portland Cement Bond Coat, complying with ANSI A118.4 and ISO 13007, C2ES2P1 with minimum compressive strength of 400 psi.

1. Laticrete, 254 Platinum.

2. MAPEI, Keraflex Super.

3. Pro Spec; Permalastic System consisting of Permalastic Dryset Mortar and Permalastic Admixture.

G. Improved Modified Cement Mortars: For use with large format tile (LFT), complying with ANSI 118.15 and ISO 13007, CSES2PS.

1. Laticrete, MultiMax Lite.

2. Mapei; Keraflex Super.

3. Pro Spec; StayFlex 590.

H. Wall and Base Tile

1. Over drywall, use ANSI A136.1-1967 Organic Adhesive for installation of Ceramic Tile, Type I and ISO 13007 D2TE. Shear strength shall be 50 psi minimum. Adhesive primer as recommended by adhesive manufacturer. Manufacturer shall certify, in writing, that adhesive and primer used are proper types for the intended tile types and application. Conform to TCA Detail W-242.

a. Laticrete Premium 15 Adhesive.
b. MAPEI Type 1 Mastic.
c. ProSpec B-1000 Tile Adhesive.

2. Over masonry and concrete, use a mortar bed leveling coat conforming to ANSI A108.1A followed by a Latex Portland Cement Bond Coat: Laticrete "TriLite," MAPEI "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007-C2ES2P1, and TCA Detail W-211.

3. Over cement board, use a Latex Portland cement mortar bond coat: Laticrete "TriLite," MAPEI, "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007-C2ES2P1, and TCA Detail W-244; coat back of board with waterproof membrane as specified below.

4. Over glass-mat, water-resistant gypsum backer board, use a latex Portland cement mortar bond coat: Laticrete "TriLite," MAPEI "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007- C2ES1P1, and TCA Detail W-245.

I. Floor Tile and Stone Saddle - Mud Set: Set floor tile and stone saddle using Portland Cement mortar setting bed conforming to ANSI A108.1A and latex modified Portland cement bond coat. Basis of Design: Laticrete "254 Platinum" or MAPEI "Keraflex Super," conforming to ANSI A118.4, ISO 13007-C2ES1P1, and TCA Detail F-112.

1. For installation of LFT: Improved Modified Cement Mortars and medium bed; Basis of Design: Laticrete "Multi Max Lite," or MAPEI "Ultraflex LFT," conforming to ANSI 118.15, ISO 13007-C2ES1P1.

J. Floor Tile and Stone Saddle - Thin Set over Waterproof Setting Bed: Set floor tile and stone saddle using thin set latex Portland cement bond coat. Basis of Design: Laticrete "254 Platinum" or MAPEI "Keraflex Super" conforming to ANSI A118.4, ISO 13007-C2ES2P1, and waterproofing membrane conforming to TCA Detail F-122/122A.

1. For installation of LFT: Improved Modified Cement Mortars and medium bed; Basis of Design: Laticrete "Multi Max Lite," or MAPEI "Ultraflex LFT," conforming to ANSI 118.15, ISO 13007-C2ES1P1.

K. Waterproofing Membrane: Complying with ANSI A118.10 and ANSI A118.12; and having IAPMO certification as a shower pan liner; provide "Hydro Ban" made by Laticrete International, "Mapelastic AquaDefense" by MAPEI with factory blended "Bio-Block Antimicrobial," ProSpec "B6000," or approved equal.

1. Reinforce membrane with polyester fabric where recommended by manufacturer.

L. Water: Clean, fresh and suitable for drinking.

M. Grout: Complying with A118.7; and ISO 13007, CG2WAF; for grouting ceramic tile, provide a commercial Portland cement grout, Laticrete "PermaColor" or "PermaColor Select," "Ultracolor Plus FA" (additive not required) made by MAPEI, or comparable product by Custom Building Products or approved equal; color as selected by the Architect.

N. Physical Properties: The setting beds and grouts must meet the following physical requirements:

1. Compressive Strength: 3000 psi min.

2. Shear Bond Strength: 500 psi min.

3. Water Absorption: 4.0% max.

4. Service Rating (ASTM C 627): Extra Heavy Duty.

O. Sealer: Seal all grout joints and all unglazed tile using "StoneTech Heavy Duty Sealer" by Laticrete, "Sealer's Choice 15 Gold" by Aqua Mix Inc. or "Ultracare Penetrating Plus Stone, Tile, and Grout Sealer" by MAPEI.

P. Temporary Protective Coating: Either product indicated below that is applied in the tile manufacturer's factory and 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. Petroleum paraffin wax, applied hot, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg. F. per ASTM D 87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

Q. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, equal to "StoneTech Stone & Tile Cleaner" by Laticrete, "Concentrated Stone & Tile Cleaner" Aqua-Mix, "Ultracare Concentrated Tile & Grout Cleaner" by MAPEI, or approved equal, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 SEALANT

A. Joint Backing: Preformed, compressible, resilient, non-extruding, non-staining strips of foam neoprene, foam polyethylene, or other material recommended by sealant manufacturer.

B. Bond Breaker: Polyethylene tape, 3 mils thick, or other material recommended by sealant manufacturer.

C. Sealant Primer: Colorless, non-staining, or type to suit substrate surface, as recommended by sealant manufacturer.

D. Sealant: One-part silicone based sanitary sealant, conforming to ASTM C 920, Type S, Grade NS, Class 25. Sealant hardness upon full cure shall be between 20-30 Shore "A" Durometer. Color of sealant to blend with or match adjacent materials, and as selected by the Architect. Sealant shall be equivalent to 1700 Sanitary Sealant made by General Electric or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where ceramic tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels in Floors: + 1/8" in 10'-0" distance and 1/4" total max. variation from levels shown.

B. Grind or fill concrete and masonry substrates as required to comply with allowable variations.

C. Concrete substrates must meet ANSI A108.01 tolerances and surface textures in preparation for tile work. Coordinate with concrete trades.

3.3 PREPARATION

A. Coordinate the following with Section 033000:

1. Steel trowel and fine broom finish concrete slabs that are to receive ceramic tile. Cure concrete slabs that are to receive tile before tile application. Do not use liquid curing compounds or other coatings that may prevent bonding of tile setting materials to slabs. Slab shall be dry at time of tile installation.

2. Tile floors with floor drains must have a slope to direction of 1/4" per foot; coordinate this with concrete trades.

B. Etch concrete substrate as may be required to remove curing compounds or other substances that would interfere with proper bond of setting bed. Rinse with water to remove all traces of treatment.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of 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.

D. Field Applied Temporary Protective Coating: Pre-coat tile with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.4 JOINTS IN TILE WORK

A. Joint Widths: 1/16" wide in ceramic tile.

B. Alignment: Wall, base and floor joints shall align through the field and trim. Direction and location of all joints as directed by Architect.

C. Movement Joints: Conform to TCA Detail EJ171. Locate where movement joints are in back-up material. Provide movement joint at joints between mop receptors and ceramic tile. Provide movement joint at all vertical internal joints of wall tile. Movement joints 1/8" wide in ceramic tile. Fill all movement joints with specified backing and sealant. Use bond breaker where sufficient space for joint backing does not exist.

1. Provide sealant between ceramic tile and plumbing fixtures, mirrors, pipes, countertops and other dissimilar materials penetrating or adjacent to ceramic tile.

3.5 INSTALLATION

A. Comply with the following installation standards:

1. Wall tile over drywall using organic adhesive - ANSI A136.1 and ISO 13007, D2TE.

2. Wall tile over cement board or glass mat backer board using dry set mortar with latex additive - ANSI A118.4 and ISO 13007, C2ES1P1.

3. Wall tile over masonry or concrete using dry set mortar with latex additive - ANSI A118.4 and ISO 13007, C2ES1P1.

4. Floor tile using full mud set mortar - ANSI A118.4, A228.15, and ISO 13007, C2ES1P1.

5. Floor tile using dry set mortar with latex additive - ANSI A118.4, A118.15, and ISO 13007, C2ES1P1.

6. Floor tile over waterproofing membrane - A118.15, and ISO 13007, C2ES1P1.

B. Backs of tile must be cleaned before installation.

C. All setting beds and/or adhesives shall provide for an average contact area of not less than 95% coverage.

D. Allowable Variations in Finished Work: Do not exceed the following deviations from level and plumb, and from elevations, locations, slopes and alignment shown.

1. Floors: 1/8" in 10'-0" run, any direction; +/- 1/8" at any location; 1/32" offset at any location.

2. Walls: 1/8" in 8'-0" run, any direction; 1/8" at any location; offset at any location, 1/32".

3. Joints: +/- 1/32" joint width variation of any location; 1/16" in 3'-0" run deviation from plumb and true.

E. Handle, store, mix and apply setting and grouting materials in compliance with the manufacturer's instructions.

F. Extend tile work into recesses and under equipment and fixtures, to form a complete covering without interruptions. Terminate work neatly at obstructions, edges and corners without disruption of pattern or joint alignment.

G. 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 and fixtures so that plates, collars, or covers overlap tile.

H. Lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are the same size. Lay out tile work and center tile fields both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.

3.6 INSTALLATION OF STONE SADDLES

A. Install stone saddles cut to profiles and sizes shown, accurately fitted to jambs, coped at stops, set in thinset herein specified, and with grouted edge joints as specified for floor tile.

3.7 CLEANING AND PROTECTION OF CERAMIC TILE

A. Cleaning: On 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. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use cleaners only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning to insure removal of all cleaning material.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. Apply coat of sealer to all grout joints and all unglazed tile.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings from tile surfaces.

E. Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the acoustical panel ceilings as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Acoustical panel units.
2. Exposed "T" suspension system, including hangers and inserts.
3. Provisions for the installation of lighting fixtures, diffusers, grilles, and similar items provided under other Sections.
4. Cutting, drilling, scribing, and fitting as required for electro-mechanical penetrations.
5. Perimeter and column moldings, trim, and accessories for acoustical ceilings.

1.3 RELATED SECTIONS

A. Steel Deck - Section 053100.

B. Drywall ceilings - Section 092900.

C. Diffusers, grilles, and related frames - Division 23.

D. Lighting fixtures - Division 26.

1.4 QUALITY ASSURANCE

A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations published by the Ceilings and Interior Systems Contractor’s Association.

B. Qualifications of Installers

1. The suspended ceiling subcontractor shall have a record of successful installation of similar ceilings acceptable to Architect and shall be currently approved by the manufacturer of the ceiling suspension system.
2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

C. The work is subject to the following standards:

1. ASTM C 635 "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings," American Society for Testing and Materials.

2. ASTM C 636 "Standard Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels," American Society for Testing and Materials.

D. In addition to suspension system specified, provide seismic struts and seismic clips to meet seismic standards as required by prevailing Codes and Ordinances.

1.5 SUBMITTALS

A. Shop Drawings: Submit completely dimensioned ceiling layouts for all areas where acoustical ceilings are required, showing:

1. Any deviations from Architect's reflected ceiling plan layouts, especially lighting fixture and dimensions. Also indicate if any light fixtures will not fit into Architect's ceiling layout due to dimensional restrictions or field conditions.

2. Direction and spacing of suspension members and location of hangers for carrying suspension members.

3. Direction, sizes and types of acoustical units, showing suspension grid members, and starting point for each individual ceiling area.

4. Moldings at perimeter of ceiling, at columns and elsewhere as required due to penetrations or exposure at edge of ceiling tiles.

5. Location and direction of lights, air diffusers, air slots, and similar items in the ceiling plane.

6. Details of construction and installation at all conditions.

7. Materials, gauges, thickness and finishes.

B. Samples and Product Literature: Submit the following samples and related manufacturer's descriptive literature.

1. Twelve (12) inch long components of suspension systems, including moldings.

2. Acoustical units — full size.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units 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 or other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Do not install acoustical ceilings until wet-work in space is completed and nominally dry, work above ceilings has been completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition system.

1.9 EXTRA STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0% of amount installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. Provide 3/4" thick, 24" x 24" mineral fiber panels equal to "Ultima" with square edge, as manufactured by Armstrong World Industries, or equal made by USG Interiors, Inc. or Rockwool Rockfon. Panels shall have factory applied white finish with light reflectance value of 0.88. Panels shall meet ASTM E 1264, Type IV, Form 2, Pattern E, Class A, with maximum flame spread of 25 and smoke developed of 50 per ASTM E 84.

2.2 SUSPENSION SYSTEM

A. Provide steel suspension system with low sheen white baked enamel finish equal to "Prelude," 15/16" exposed-tee, 2-way grid system made by Armstrong World Industries, or equal made by USG Interiors, Inc. or Chicago Metallic Corp.

B. The suspension system shall support the ceiling assembly shown on the drawings and specified herein, with a maximum deflection of 1/360 of the span, in accordance with ASTM C 635.

C. Provide min. 12 ga. galvanized wire hangers, soft annealed steel conforming to ASTM A 641, prestretched, Class 1 zinc coating, soft temper, size so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire.

D. Provide ceiling clips and inserts to receive hangers, type as recommended by suspension system manufacturer, sizes for pull-out resistance of not less than five (5) times the hanger design load, as indicated in ASTM C 635.

E. Suspension systems shall conform to ASTM C 635, intermediate duty.

F. Provide manufacturer’s standard wall moldings with off-white baked enamel finish to match suspension systems. For circular penetrations of ceilings, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas where acoustical panel ceilings are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the layout.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. Codes and Standards: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations and industry standards.

B. Install suspension systems to comply with ASTM C 636, with wire hangers supported only from building structural members. Locate hangers not more than 6" from each end and spaced 4'-0" along direct-hung runner, leveling to tolerance of 1/8" in 12'-0".

C. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.

D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, reinforcing, countersplaying or other equally effective means.

E. Install edge moldings at edges of each acoustical ceiling area, and at locations where edge of acoustical units would otherwise be exposed after completion of the work.

1. Secure moldings to building construction by fastening through vertical leg. Space holes not more than 3" from each end and not more than sixteen (16) inches o.c. between end holes. Fasten tight against vertical surfaces.

2. Level moldings with ceiling suspension system, to a level tolerance of 1/8" in 12'-0".

F. Install acoustical units in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

G. Install hold-down clips in toilet areas, and in areas where required by governing regulations; space 2'-0" o.c. on all cross tees.

H. Light fixtures or other ceiling apparatus shall not be supported from main beams or cross tees if their weight causes the total load to exceed the deflection capability of the ceiling suspension system. In such cases the load shall be supported by supplemental hangers furnished and installed by this Section of work.

I. Where fixture or ceiling apparatus installation causes eccentric loading on runners, provide stabilizer bars to prevent rotation.

3.4 ADJUST AND CLEAN

A. Clean exposed surfaces of acoustical ceilings, including trim, edge molding, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 095133 - METAL CEILINGS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the metal ceilings as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Exterior metal plank ceiling.

2. Suspension system, including hangers and inserts.

3. Provisions for the installation of lighting fixtures, diffusers, grilles, and similar items provided under other Sections.

4. Cutting, drilling, scribing, and fitting as required, including for all electro/mechanical penetrations.

5. Perimeter, transition, and column moldings, trim and accessories for acoustical ceilings and acoustical metal ceilings.

1.3 RELATED SECTIONS

A. Lighting - Division 26.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers

1. The suspended ceiling subcontractor shall have a record of successful installations of similar ceilings acceptable to the Architect and shall be currently approved by the manufacturer of the ceiling suspension system.

2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations published by the Ceilings and Interior Systems Contractors' Association.

C. The work is subject to applicable portions of the following standards:

1. ASTM C 635 "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings," American Society for Testing and Materials.

2. ASTM C 636 "Standard Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels," American Society for Testing and Materials.

D. In addition to suspension system specified, provide seismic struts and seismic clips to meet seismic standards as required by prevailing Codes and Ordinances.

E. Comply with wind uplift requirements.

1.5 SUBMITTALS

A. Shop Drawings: Submit completely dimensioned ceiling layouts for all areas where metal acoustical tile ceilings are required, showing:

1. Any deviations from Architect's reflected ceiling plan layouts, especially lighting fixture and dimensions. Also indicate if any light fixtures will not fit into Architect's ceiling layout due to dimensional restrictions of field conditions.

2. Direction and spacing of suspension members and location of hangers for carrying suspension members.

3. Direction, sizes, and types of metal acoustical units, showing suspension grid members, and starting point for each individual ceiling area.

4. Moldings at perimeter of ceiling, at columns and elsewhere as required due to penetrations or exposure at edge of ceiling tiles.

5. Location and direction of lights, air diffusers, air slots, and similar items in the ceiling plane.

6. Details of construction and installation at all conditions.

7. Materials, gauges, thicknesses, and finishes.

B. Samples: Submit samples, including manufacturer's descriptive literature for:

1. All components of suspension systems, including moldings.

2. 2' x 2' of metal plank and color.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units 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 or other causes.

B. Handle metal acoustical ceiling units carefully to avoid damaging units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition system.

1.9 EXTRA STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Metal Ceiling Units: Furnish quantity of full-size units equal to 5.0% of amount installed.

2. Provide extra stock for trim at future circular penetration of ceilings.

PART 2 PRODUCTS

2.1 ACOUSTICAL METAL PLANK CEILING

A. Basis of Design: Armstrong MetalWorks Linear metal ceiling plank, nonperforated, in color selected by Architect,

2.2 SUSPENSION SYSTEM

A. Linear System: Provide Metalworks Linear Grid System system complete with sub-members, hangers, clips, accessories, and trim, of the sizes and strengths required to accommodate and support the ceiling units and other work supported by the ceiling system; with deflections limited to 1/360 of spans (between support points of members). Provide exposed moldings, finished to match acoustic panels.

B. Provide ceiling clips, cover plates and inserts to receive hangers, type as recommended by suspension system manufacturer, sized for pull-out resistance of not less than 5 times the hanger design load as indicated in ASTM C 635, Table 1, Direct Hung.

C. Provide min. 12 ga. galvanized wire hangers, soft annealed steel conforming to ASTM A 641, prestretched, Class 1 zinc coating, soft temper, size so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire.

D. Main carrying channels, to which suspension systems shall be fastened, shall be 1-1/2" cold rolled galvanized steel channel; spaced 4'-0" o.c.

E. Suspension system shall conform to ASTM C 635, intermediate duty, with deflection limited to 1/360 of span.

F. For circular penetrations of ceilings, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas where metal ceilings are to be installed and correct any of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

B. Measure each ceiling area and establish layout of metal acoustic units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. Codes and Standards: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations and industry standards.

B. Install anchor rod systems to comply with ASTM C 636, as applicable, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along direct-hung runner, leveling to tolerance of 1/8" in 12'-0".

C. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, reinforcing, countersplaying or other equally effective means.

D. Install edge moldings at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.

1. Screw-attach moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.

E. Scribe and cut metal acoustical units for accurate fit at borders and at interruptions and penetrations by other work through the ceilings. Stiffen edges of cut units as required to eliminate evidence of oil-canning or buckling.

F. Install snap-in acoustical units, complete with acoustical pads, in coordination with suspension system and exposed moldings.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions.

2. Fit adjoining tile to form flush, tight joints. Scribe and cut for accurate fit at borders and around work which penetrates ceiling.

G. Light fixtures or other ceiling apparatus shall not be supported from main beams or cross tees if their weight causes the total load to exceed the deflection capability of the ceiling suspension system. In such cases the load shall be supported by supplementary hangers furnished and installed by this Section of work.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces of metal units, and of trim, edge moldings and suspension members; comply with manufacturers' instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient tile flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Rubber base.

2. Accessories.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Resilient Tile Flooring - Section 096519.

C. Carpet Tile - Section 096813.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples: Submit six (6) inch long samples of base and strips.

1.6 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.7 JOB CONDITIONS

A. Continuously heat spaces to receive base to a temperature of seventy (70) degrees F. for at least forty-eight (48) hours prior to installation, whenever project conditions are such that heating is required. Maintain seventy (70) degrees F. temperature continuously during and after installation as recommended by the manufacturer, but for not less than forty-eight (48)

hours. Maintain a temperature of not less than fifty-five (55) degrees F. in areas where work is completed.

PART 2 PRODUCTS

2.1 RUBBER BASE

A. Provide 4" high by 1/8" thick continuous vulcanized SBR rubber top set cove base with pre-formed internal and external corner pieces, color as scheduled on the drawings. For areas to receive carpet, provide flat base, no cove. Base shall conform to ASTM F 1861, Type TS, Group 1 (solid) as manufactured by Roppe, or comparable product by Johnsonite/Tarkett, Nora, or approved equal.

2.2 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the tile manufacturer for the type of service indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient base is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. In all spaces where base is indicated, install bases tight to walls, partitions, columns, built-in cabinets, etc., without gaps at top or bulges at bottom, with tight joints and flush edges, with molded corner pieces at internal and external corners. Provide end stops adjacent to flush type door frames and where base does not terminate against an adjacent surface. Keep base in full contact with walls until adhesive sets.

3.3 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from base using neutral type cleaners as recommended by the manufacturer.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient tile flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Vinyl composition tile.
2. Transition strips.
3. Accessories.

1.3 RELATED SECTIONS

A. Resilient Base and Accessories - Section 096513.

B. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples

1. Submit full-size sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
2. Submit six (6) inch long samples of transition strips.

C. Submit manufacturer’s warranty as noted herein.

1.6 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F. or more than 95 deg F., in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F. or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.8 WARRANTY

A. Provide manufacturers 5-year limited warranty.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE (VCT)

A. Provide 12" x 12" x 1/8" thick vinyl composition tile conforming to ASTM F 1066, Class 2 (through-pattern), Type II, in colors as selected by the Architect, equal to "Standard Excelon" made by Armstrong, or comparable product by Johnsonite Tarkett, or approved equal. Provide tile units with uniformly distributed color and pattern throughout the thickness of tile. Variations in shades and off-pattern matches between containers are not acceptable.

2.2 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the tile manufacturer for the type of service indicated based on a RH of 90%.

B. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

C. Leveling Compound: As specified in Section 035416.

D. Edging Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color as selected by the Architect from manufacturer's standards.

E. Finish

1. Cleaner shall be equal to "Super Shine All" made by Hillyard Chemical Co., or approved equal.

2. Wax shall be equal to "Super Hil-Brite" made by Hillyard Chemical Co., or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient tile flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 INSTALLATION

A. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by tile manufacturer.

B. Place tile units with adhesive cement in strict compliance with the manufacturer's recommendations. Butt tile units tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend tile units into toe spaces, door reveals, and into closet and similar openings.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking devices.

D. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

E. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped, or deformed tile is not acceptable.

F. Tightly cement tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections.

G. Lay tile with grain in all tile running in the same direction.

H. Place resilient edge strips tightly butted to tile and secure with adhesive. Provide edging strips at all unprotected edges of tile, unless otherwise shown.

3.5 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from tile, using neutral type cleaners as recommended by the tile manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean tile floors and accessories. Apply two (2) coats of wax and buff using materials as specified herein.

END OF SECTION

SECTION 096566 - RESILIENT ATHLETIC FLOORING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient athletic flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Recycled rubber flooring.

2. Accessories.

1.3 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.4 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples: Submit full-size sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.5 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.6 ATTIC STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Furnish quantity of full-size units equal to 10.0% of amount installed of athletic flooring type and size.

1.7 JOB CONDITIONS

A. Continuously heat spaces to receive tile to a temperature of seventy (70) degrees F. for at least forty-eight (48) hours prior to installation, whenever project conditions are such that heating is required. Maintain seventy (70) degrees F. temperature continuously during and after installation as recommended by the tile manufacturer, but for not less than forty-eight (48) hours. Maintain a temperature of not less than fifty-five (55) degrees F. in areas where work is completed.

PART 2 PRODUCTS

2.1 RECYCLED RUBBER FLOORING MATERIALS

A. Product: Provide Pliteq FIT70 recylced rubber flooring or approved equal.

1. Tile Dimension: 24" x 24" x 70mm thick.

2. Color(s): Refer to Interior Finish Schedule.

B. Rubber flooring shall be manufactured from a combined of 100% post-consumer recycled SBR (styrene butadiene rubber), EPDM (ethylene propylene diene monomer) rubber granules, and polyurethane.

C. Physical Properties: Provide flooring system that meets or exceeds the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.

1. Tensile Strength (ASTM D 412): 200 lbs./sq. in. minimum.

2. Static Load, 400 lb./sq. in. (ASTM F 970): 1000 psi (modified test).

3. Coefficient of Friction (ASTM D 2047): Less than 0.9.

4. Ambient Noise Reduction (ASTM C 423): 0.10 sabine/sq. ft.

5. Impact Insulation Class (ASTM E 492): 0.45 minimum.

6. Thermal Conductivity (ASTM C 518): +/- 0.406 BTU-in/hr-sq.ft.-deg. F (approx.).

2.2 ACCESSORIES

A. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

B. Leveling Compound: Latex/Portland cement flash patching and leveling compound equal to No. 226 with 3701 admixture made by Laticrete or equal made by Mapei, H.B. Fuller, or approved equal.

C. Adhesive: As approved by the indoor resilient athletic surfacing manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient athletic flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 PREPARATION

A. Etch concrete substrate as may be required to remove curing compounds or other substances that would interfere with proper bond of adhesive for tile. Rinse with water to remove all traces of treatment.

B. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and are ready to receive tile installation.

C. Concrete Primer: Apply concrete slab primer if recommended by tile manufacturer, prior to application of the adhesive. Apply in compliance with manufacturer's directions.

3.4 ALLOWABLE TOLERANCES

A. Allowable Tolerances in Finished Work: Do not exceed the following deviations from level and plumb, and from elevations, locations, slopes and alignment shown.

1. Floors: 1/8" in 10'-0" run, any direction; 1/32" offset at any location.

3.5 INSTALLATION

A. The installation area shall be closed to all traffic and activity for a period to be set by the indoor resilient athletic surfacing installer. The indoor resilient athletic surfacing installation shall not begin until the installer is familiar with the existing conditions.

B. All necessary precautions should be taken to minimize noise, smell, dust, the use of hazardous materials and any other items that may inconvenience others.

C. Install the indoor resilient athletic surfacing in strict accordance with the indoor resilient athletic surfacing manufacturer’s written instructions.

D. Install the indoor resilient athletic surfacing minimizing cross seams. Provide a seam diagram during the submittal process for approval prior to installation.

E. Install appropriate threshold plates or transition strips where necessary.

3.6 CLEANING AND PROTECTION

A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

SECTION 096723 - EPOXY RESIN COMPOSITION FLOORING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the epoxy resin composition flooring and base as scheduled on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Floor drains - Division 22.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Submit manufacturer's technical data application instructions and general recommendations for the epoxy resin composition flooring specified herein.

C. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors and finishes available.

1. Submit 3" x 3" samples of color chips from color chart selection designated by the Architect.

D. Material certificates signed by manufacturer certifying that the epoxy resin composition flooring complies with requirements specified herein.

E. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer or applicator who has specialized in installing resinous flooring types similar to that required for this Project and who is acceptable to manufacturer of primary materials.

B. Single-Source Responsibility: Obtain epoxy resin composition flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels containing brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Comply with epoxy resin composition flooring manufacturer's directions for maintenance of substrate temperature, moisture, ventilation, and other conditions required to execute and protect Work.

B. Lighting: Permanent lighting will be in place and working before installing resinous flooring.

PART 2 PRODUCTS

2.1 MATERIALS

A. Troweled epoxy resin composition flooring shall be Dex-O-Tex Cheminert "K" with Posi-Tred "O" top finish as manufactured by Crossfield Products Corp.; Compton, CA; Roselle Park, NJ; Hinsdale, IL; Moss Point, MS; or Sherwin Williams (G-P) TPM #115-U4 Upgraded Trowelled Mortar System, or approved equal.

2.2 PROPERTIES

A. Colors: As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Physical Properties: Provide flooring system that meet or exceed the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.

1. Compressive Strength (ASTM C 579): 11,000 psi.

2. Tensile Strength (ASTM C 307): 1643 psi.

3. Flexural Strength (ASTM C 580): 4,300 psi.

4. Flexural Modulus of Elasticity (ASTM C 580): 2.0×10^6 psi.

5. Water Absorption (MIL D-3134): 0.3 percent max.

6. Surface Hardness (ASTM D-2240): 85.5 Durometer "D".

7. Abrasion Resistance (ASTM D-1044): 0.0 gr.

8. Indentation (MIL-D-3134): 0.024" max.

9. Impact Resistance (Gardner Impact Tester): No chipping, cracking, or delamination and not more than 0.014".

10. Adhesion (A.C.I. Comm. No. 403): 400 psi.

11. Electrical Conductivity (NFPA 56A): Di-electric.

12. Critical Radiant Flux (ASTM E-648): Greater than 1.07 watts/cm^2.

13. Co-efficient of Friction - Rubber Shoe Surface (MIL-D-3134 Test Procedure)

Profiles	Static Friction Saltwater Solution on Surface	Static Friction Oil on Surface	Sliding Friction Saltwater Solution on Surface	Sliding Friction Oil on Surface
Fine Profile	0.95	0.75	0.89	0.44
Medium Profile	1.03	0.75	0.95	0.45
Coarse Profile	1.09	0.85	1.00	0.56
Very Coarse Profile	1.24	0.78	1.04	0.59

2.3 SUPPLEMENTAL MATERIALS

A. Joint Sealant: Type recommended or produced by manufacturer of epoxy resin composition flooring system for type of service and joint condition indicated.

B. Waterproofing Membrane: Type recommended or produced by manufacturer of epoxy resin composition flooring system for type of service and floor condition indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the epoxy resin composition flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

B. Coordinate work with other trades to insure that concrete substrate has been "wet" cured only.

3.2 PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to flooring manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry, and neutral substrate for flooring application.

B. Concrete Surfaces: Shot-blast, acid etch, or power scarify as required to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, efflorescence, and any curing compounds or form release agents. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.

C. Materials: Mix resin and hardener, add colorant and aggregate when required, and prepare materials according to flooring system manufacturer's instructions.

3.3 APPLICATION

A. General: Apply each component of epoxy resin composition flooring system according to manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated.

B. Bond Coat: Apply bond coat over prepared substrate at manufacturer's recommended spreading rate. Coordinate applying bond coat with topping mix to ensure optimum adhesion between flooring materials and substrate.

C. Body Coat: Over freshly applied primer, trowel apply epoxy mortar mix at 1/4-inch thickness. Hand or power trowel and grout with epoxy to fill voids. When cured, sand, if necessary, to remove trowel marks and roughness.

D. Finish or Sealing Coats: After body coat has cured sufficiently, apply finish or sealing coats of type recommended by flooring manufacturer to produce finish matching approved sample and in number of coats and spreading rates recommended by manufacturer.

1. Final finish coat shall be in color and skid retardant profile as approved by the Architect.

2. Finish floor shall be 1/4" thick, uniform in color and free of travel marks.

E. Cove Base: Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise indicated. Round interior and external corners. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

F. Joints: Where substrate is interrupted by expansion or control joints, provide joint in flooring to comply with details indicated or, if not otherwise indicated, as recommended by flooring manufacturer.

1. Apply joint sealant materials to comply with resinous flooring manufacturer's recommendations.

3.4 CURING, PROTECTION AND CLEANING

A. Cure epoxy resin composition flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

B. Protect epoxy resin composition flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and application method.

C. Cleaning: Remove temporary covering and clean epoxy resin composition flooring just before final inspections. Use cleaning materials and procedures recommended by flooring manufacturer.

END OF SECTION

SECTION 096813 - CARPET TILE

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 SECTION INCLUDES

A. Work of this Section includes all labor materials, equipment, and services necessary to complete the carpet tile as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Carpet tile.

2. Adhesive.

1.3 RELATED SECTIONS

A. Concrete sub-floor - Section 033000.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm with not less than five (5) years of experience in installation of commercial carpeting of type, quantity, and installation methods similar to work of this Section.

B. General Terminology/ Information Standard: Refer to current edition of "Carpet Specifier's Handbook" by The Carpet and Rug Institute; for definitions of terminology not otherwise defined herein, and for general recommendations and information.

C. Carpet used on Project must be from same dye lot for each carpet type.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical product data for each type of carpet, cushion and accessory item required.

B. Samples: Submit full size samples of carpet tile and six (6) inches long samples of each type exposed edge stripping.

C. Certification: Submit manufacturer's certification stating that carpet materials furnished comply with specified requirements.

1. Include listing of mill register numbers for carpet furnished.

2. Include supporting certified laboratory test data indicating that carpet meets or exceeds specified test requirements.

D. Maintenance Data: Submit manufacturer's printed maintenance recommendations, including methods and frequency recommended for maintaining carpet in optimum conditions under anticipated traffic and use conditions.

1.6 EXTRA STOCK

A. Produce and deliver to project at least five (5) percent overrun on calculated yardage. Provide required overrun exclusive of carpet needed for proper installation, waste and usable scraps.

1.7 PRODUCT DELIVERY AND STORAGE

A. Deliver carpeting materials in original mill protective wrapping with mill register numbers and tags attached. Store inside, in a well-ventilated area, protected from weather, moisture and soiling.

1.8 WARRANTY

A. Provide special project warranty, signed by Contractor and Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during two (2) year warranty period following substantial completion. Attach copies of product warranty.

PART 2 PRODUCTS

2.1 CARPET TILE

A. Provide carpet tile of design and color scheduled on the drawings.

2.2 ACCESSORIES

A. Adhesive for Carpet Tile: Provide release type adhesive as recommended by the carpet tile manufacturer for use with carpet tile specified. Provide adhesive which complies with flame spread rating required for the carpet installation.

B. Miscellaneous Materials: Provide the types of adhesives and tape, and other accessory items recommended by the carpet manufacturer and Installer for the conditions of installation and use.

C. Leveling Compound: Latex/Portland cement flash patching and leveling compound equal to No. DSP-520 made by H.B. Fuller or No. 226 with 3701 admixture made by Laticrete or equal made by Mapei, or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpet tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PRE-INSTALLATION REQUIREMENTS

A. Floor shall be clean and free of cracks and protrusions. Any gaps or cracks more than 1/16" wide to be filled in with latex leveling compound. Protrusions must be sanded down smooth, the floor cleanly swept and vacuumed if necessary to remove all dust and grit.

B. Floor temperature shall be 65 deg., at least 24 hours prior to installation; and 48 hours after carpet is installed.

C. Conduct a moisture test. The presence of moisture in the concrete floor will interfere with the curing and subsequent performance of the adhesive. Conduct the test as follows:

1. Drive a concrete nail a half inch into the floor. Then remove the nail.

2. Place a small amount of anhydrous calcium chloride or calcium sulphate crystals over the hole.

3. Cover the crystals and the hole with a piece of flat glass and seal the edges with waterproof tape or putty. Since concrete pourings vary, repeat the test every 1500 sq. ft.

4. Leave in place 72 hours. Any color change in the crystals indicates the presence of moisture. Do not apply carpet until slab is free of moisture and meets with approval of carpet adhesive manufacturer.

D. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions and recommendations. Maintain direction of pattern and texture, including lay of pile.

B. Adhere all tiles with a full spread of adhesive. Dry-fit cut tiles and apply adhesive to tile back after tile has been cut.

C. Tiles shall be installed in a monolithic corner to corner manner following arrows printed on back of each tile indicating pile direction. Tiles shall be installed to achieve patterns as directed by the Architect.

D. Vinyl reducer strips shall be used along any necessary open edges so as to maintain the fixed perimeter.

3.4 CLEANING UP

A. Upon completion of the carpeting installation in each area, visually inspect all carpet installed in that area and immediately remove all dirt, soil, and foreign substance from the exposed face; inspect all adjacent surfaces and remove all marks and stains caused by the carpet installation: remove all packaging materials, carpet scraps, and other debris from the carpet installation to the area of the job site set aside for its storage.

3.5 PROTECTION

A. In all areas, provide a temporary non-staining paper pathway in the direction of traffic.

END OF SECTION

SECTION 096900 - ACCESS FLOORING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the stringer-type access floor system as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Access flooring panels and understructure
2. Floor panel coverings
3. Various accessories, including, but not limited to ramps, steps and electrical boxes.

1.3 RELATED SECTIONS

A. Sealer for concrete floors below access floor - Section 033000.

B. Connection to ground of access floor understructure - Division 26.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm approved by access flooring manufacturer and that has successfully installed access flooring systems of a scope similar to that of this project.

B. NFPA Standard: Provide access flooring which, when installed, complies with requirements of NFPA No. 75 for raised floors.

1.5 ENVIRONMENTAL CONDITIONS FOR STORAGE AND INSTALLATION

A. Prior to and during installation, a secure and dry storage space closed to the weather must be available for the access floor materials, with environment at 40° F to 90° F and approximately 35% to 70% relative humidity, 24 hours a day during and after installation.

B. The subfloor surface must be free of moisture, dust, dirt and other debris. Once installed, the access floor must be maintained in the same manner.

1.6 DESIGN PERFORMANCE AND CERTIFICATION OF PRODUCT

A. Provide access flooring system consisting of moveable assemblies composed of modular floor panels supported on pedestals forming accessible under floor cavities to accommodate electrical, mechanical, and HVAC services and complying with performance requirements specified. Raised floor panels must be interchangeable with each other except where cut for special conditions.

B. Load testing shall be performed according to "Recommended Test Procedures for Access Flooring" as established by the Ceiling and Interior Systems Construction Association (CISCA). These procedures shall be used as a guideline when presenting load performance product information.

C. Product test shall be witnessed and certified by an accredited independent engineering and testing laboratory based in the U.S.A. with a minimum of five (5) years' experience testing access floor components in accordance with CISCA test methods.

1.7 SUBMITTALS

A. Samples: Submit a sample of the floor panel and each understructure component.

B. Shop Drawings:

1. Submit drawings showing raised floor panel layout including starting point of installation.

2. Include details of component panels and pedestals. If required, show edge details of ramps, steps, handrails, and anchoring of pedestal bases to subfloor.

C. Certificates

1. Submit independent testing organization certificates indicating compliance with specified design criteria when tested and reported according to CISCA "Recommended Test Procedures for Access Floors."

2. Submit seismic calculations in accordance with prevailing building code. Calculations shall be performed using a current seismic program and prepared by a structural engineer licensed in the state where the project is located. The structural engineer shall sign and seal these calculations confirming that these calculations meet all local and state codes for seismic pedestal assemblies. A signed copy of these calculations must be given to the Architect.

1.8 TOLERANCES

A. Manufacturing Tolerance

1. Nominal Panel Size: ± 0.015" or less.

2. Panel Flatness: ± 0.020" or less.

3. Panel Squareness: ± 0.015" or less.

4. Panel Interchangeability: All panels, except those modified to meet special conditions, shall be interchangeable.

B. Installation Tolerance: Finished installation shall be level within ± 0.060" in 10 feet and ± 0.100" for the entire floor.

1.9 PROJECT CONDITIONS

A. The Contractor shall provide a clean, level, dry subfloor, temperature controlled, and protected from the weather.

B. Access flooring storage and installation areas shall be maintained at a temperature between 40° F to 90° F and between 35% and 70% relative humidity for 24 hours a day before, during and after installation.

C. Overhead construction work must be completed before installing access floor to avoid damage to panels and finishes.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Manufacturers: Basis of design shall be access flooring by ASM Modular Systems, Inc., consisting of FS400 access floor panels supported on a bolted stringer understructure, or comparable product by Haworth, Inc., Netfloor USA, or approved equal acceptable to the Architect.

1. Substitutions must meet or exceed design criteria.

B. Floor Panels General: Provide modular panels complying with the following requirements, that are interchangeable with other standard field panels, and can be easily relocated by one person, using a lifting device, without disturbing adjacent panels or understructure. Installed panels with floor covering in place are to be free of exposed metal edges.

1. Nominal Panel Size: 24" x 24".

2. Fabrication Tolerances: Fabricate panels to the following tolerances with squareness tolerances expressed as the difference between diagonal measurements from corner to corner.

a. Size and Squareness: Plus or minus 0.010" of required size, with squareness tolerance of plus or minus 0.015".
b. Flatness: Plus or minus 0.020", measured on a diagonal on top of the panel.

3. Panel Attachment to Understructure: By gravity.

C. Cementitious–Filled, Formed-Steel Panels: Fabricate panels with a die formed all-steel bottom pan consisting of a minimum 64 embossments, fully welded to a die-cut full-hard steel top sheet to form a structural unitized construction. Completed panels to be filled with light-weight cementitious fill. Panels to be cleaned with 3-part wash and rinse system, prior to applying a protective powder-coat epoxy finish.

1. Solid Panels: Flat, solid top surface.

2. Perforated Panels: Provide where noted on drawings; perforated top surface with holes of number, spacing and size standard with manufacturer to produce a nominal open area of 25%.

a. Finish: Provide perforated panels with manufacturer's standard finish to match solid panels.

3. Grates: Provide where noted on drawings; grating ribs arranged in manufacturer’s standard pattern to produce a nominal open area of 56%.

a. Finish: Provide grate panels with manufacturer's standard finish.

D. Pedestals: Provide manufactures standard pedestal assembly including base, column with provisions for height adjustments, and head (Cap), made of steel.

1. 1Base: Square base plate with not less than 16 square inches of bearing area.

2. Column: Welded to base plate and of height required to bring finished floor to elevations indicated.

3. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevents vibratory displacement.

4. Construct pedestal adjusting rod of minimum 3/4" diameter solid steel, and vertical column of minimum 7/8" square steel tubing. All steel components to have manufacturer's standard galvanized finish.

5. Head: Pedestal head to accept bolted stringers as specified below.

E. Stringer System: Manufacturer's modular steel stringer system designed and fabricated to interlock with pedestal head and to form a grid pattern with a stringer under each edge of each floor panel and a pedestal under each corner of each floor panel. Protect steel component against corrosion with manufacturer's standard galvanized finish.

1. Bolted Stringers: System of main and cross stringers of sizes shown below, attached to pedestal heads with 1/4-20 fasteners accessible from top of stinger.

a. 2' x 2' spacing.

2. Provide stringers that support each edge of each panel where required to meet design load criteria.

2.2 FLOOR PANEL COVERINGS

A. General: Provide factory-applied floor coverings of type indicated that are laminated by access flooring manufacturer to tops of floor panels.

B. Colors, Textures and Patterns: As selected by Architect from manufacturer's full range of colors, textures, and patterns>

C. Provide floor covering materials in colors and patterns as indicated below:

1. Standard Plastic Laminate (HPL): NEMA LD 3, High wear type, 1/8"; fabricated in one piece to cover each panel face with integrated trim serving as edging.

D. Edge Condition of HPL: Provide HPL with "Smart-Trim" integrated as an internal element of the HPL material with no machined grooves at the edge of the HPL to allow for the collection of dirt and debris.

2.3 ACCESSORIES

A. Service Cutouts: Fabricate cutouts in floor panels to accommodate cable penetrations and service outlets. Comply with requirements indicated for size, shape, number, and location.

Provide reinforcement or additional support, if needed, to make panels with cutouts comply with standard performance requirements.

1. Fit cutouts with manufacturer's standard grommets in size indicated or, where size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacture's standard plastic molding having tapered top flange. Furnish removable covers for grommets.

2. Provide foam-rubber pads for sealing annular space formed in cutouts by cables. Trim edge of cutout with molding having a double-flanged internal edge for containing and supporting foam pads.

B. Vertical Closures (Fascia): Where under floor cavity is not enclosed by abutting walls or other construction, provide manufacturer's standard metal closure plates with manufacturer's standard finish.

C. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with non-slip raised-disc runner or vinyl floor covering, and of same materials, performance, and construction requirements as the access flooring.

D. Steps: Provide steps of size and arrangement indicated with floor covering to match access flooring. Apply non-slip aluminum nosing to treads, unless otherwise indicated.

E. Panel Lifting Device: Manufacture's standard portable lifting device of type and number required for lifting panels.

1. Provide the following quantity: one lifting device per room.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the subfloor which is to receive access flooring for dryness, cleanliness, unevenness, or any irregularities that will affect the quality of the access flooring.

1. Verify that material storage and installation areas are at recommended temperature and relative humidity before, during, and after installation.

2. Verify that substrate is level to within 1/8" in 10 feet.

B. Do not commence installation of access flooring until subfloor is clean and dry, temperature controlled, and protected from the weather.

3.2 INSTALLATION

A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal locations.

B. Installer is to coordinate with other trades to maintain the integrity of the installed access flooring. All traffic on access floor shall be controlled by the Installer only. No traffic other than the access floor installation crew shall be permitted on any floor area for 48 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.

C. Floor system and accessories shall be installed by an authorized factory trained installation company with a minimum of five (5) years' experience.

D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.

E. Installer shall keep the subfloor broom clean as installation progresses.

F. Install floor diffusers as indicated on Mechanical Drawings.

G. Finished installation shall be level within +/- 0.060" in 10 feet (3m) and +/- 0.100" for the entire floor area.

H. Replace damaged materials prior to the application of field-applied surfaces.

3.3 FIELD QUALITY CONTROL

A. Take random panel from shipment received at construction site and test panel for compliance with stated load criteria.

END OF SECTION

SECTION 099000 - PAINTING AND FINISHING

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Prime painting unprimed surfaces to be painted under this Section.
2. Painting all items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged, or rusted prime coats applied by others.
3. Painting all ferrous metal (except stainless steel) exposed to view.
4. Painting all galvanized ferrous metals exposed to view.
5. Painting interior concrete block exposed to view.
6. Painting gypsum drywall exposed to view.
7. Painting concrete floors.
8. Sealing concrete floors.
9. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
10. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
11. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers, lighting fixtures, and the like, which are exposed to view through these items.
12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
13. Painting of any surface not specifically mentioned to be painted herein or on drawings, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, shall be included as though specified.

1.3 RELATED SECTIONS

A. Shop priming is required on some, but not all of the items scheduled to be field painted. Refer to other Sections of work for complete description.

B. Shop Coat on Machinery and Equipment: Refer to the Sections under which various items of manufactured equipment with factory applied shop prime coats are furnished, including, but not necessarily limited to, the following Sections. All items of equipment furnished with prime coat finish shall be finish painted under this Section.

1. Plumbing - Division 22.

2. Heating, Ventilation and Air Conditioning - Division 23.

C. Color Coding of Mechanical Piping and Electrical Conduits – Divisions 22 and 26.

1. This Color Coding consists of an adhesive tape system and is in addition to painting of piping and conduits under this Section, as specified above.

1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

A. Items of equipment furnished with complete factory finish, except for items specified to be given a finish coat under this Section.

B. Factory-finished toilet partitions.

C. Factory-finished acoustical tile.

D. Non-ferrous metals, except for items specified and/or indicated to be painted.

E. Finished hardware, except for hardware that is factory primed.

F. Surfaces not to be painted shall be left completely free of droppings and accidentally applied materials resulting from the work of this Section.

1.5 QUALITY ASSURANCE

A. Job Mock-Up

1. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 10 feet wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the Architect. Paint mock-ups to include door and frame assembly.

2. These applications when approved will establish the quality and workmanship for the work of this Section.

3. Repaint individual areas which are not approved, as determined by the Architect, until approval is received. Assume at least two paint mock-ups of each color and gloss for approval.

B. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces.

C. Paint Coordination: Provide finish coats that are compatible with the prime coat paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible

primers or remove and re-prime as required. Notify the Architect in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

D. All paints must conform to the Volatile Organic Compounds (VOC) standards of prevailing codes and ordinances.

1.6 SUBMITTALS

A. Materials List: Before any paint materials are delivered to the job site, submit to the Architect a complete list of all materials proposed to be furnished and installed under this portion of the work. This shall in no way be construed as permitting substitution of materials for those specified or accepted for this work by the Architect.

B. Samples

1. Accompanying the materials list, submit to the Architect copies of the full range of colors available in each of the proposed products.

2. Upon direction of the Architect, prepare and deliver to the Architect two (2) identical sets of samples of each of the selected colors and glosses painted onto 8-1/2" x 11" x 1/4" thick material; whenever possible, the material for samples shall be the same material as that on which the coating will be applied in the work.

C. Manufacturer's Recommendations: In each case where material proposed is not the material specified or specifically described as an acceptable alternate in this Section of these specifications, submit for the Architect's review the current recommended method of application published by the manufacturer of the proposed material.

D. Closeout Submittal

1. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual such as Sherwin Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, MSDS, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.7 PRODUCT HANDLING

A. Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.

B. Protection

1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.

2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.

3. Use all means necessary to protect paint materials before, during and after application and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 EXTRA STOCK

A. Upon completion of this portion of the Work, deliver to the Owner an extra stock of paint equaling approximately ten (10) percent of each color and gloss used and each coating material used, with all such extra stock tightly sealed in clearly labeled containers.

1.9 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F. unless otherwise permitted by the paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds eighty-five (85) percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 PRODUCTS

2.1 PAINT MANUFACTURERS

A. Except as otherwise noted, provide the painting products listed for all required painting made by one of the manufacturers listed in the paint schedule (Section 2.4). These companies are Benjamin Moore, PPG Paint (Glidden Professional), and Sherwin Williams (S-W). Comply with number of coats and required minimum mil thicknesses as specified herein.

2.2 MATERIALS

A. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only to recommended limits.

B. Colors and Glosses: All colors and glosses shall be as selected by the Architect. Certain colors will require paint manufacturer to prepare special factory mixes to match colors selected by the Architect. Color schedule (with gloss) shall be furnished by the Architect.

C. Coloring Pigment: Products of or furnished by the manufacturer of the paint or enamel approved for the work.

D. Linseed Oil: Raw or boiled, as required, of approved manufacture, per ASTM D 234 and D 260, respectively.

E. Turpentine: Pure distilled gum spirits of turpentine, per ASTM D 13.

F. Shellac: Pure gum shellac (white or orange) cut in pure denatured alcohol using not less than four (4) lbs. of gum per gallon of alcohol.

G. Driers, Putty, Spackling Compound, Patching Plaster, etc.: Best quality, of approved manufacture.

H. Heat-Resistant Paint: Where required, use heat resistant paint when applying paint to heating lines and equipment.

2.3 GENERAL STANDARDS

A. The various surfaces shall be painted or finished as specified below in Article 2.4. However, the Architect reserves the right to change the finishes within the range of flat, semi-gloss or gloss, without additional cost to the Owner.

B. All paints, varnishes, enamels, lacquers, stains and similar materials must be delivered in the original containers with the seals unbroken and label intact and with the manufacturer's instructions printed thereon.

C. All painting materials shall bear identifying labels on the containers with the manufacturer's instructions printed thereon.

D. Paint shall not be badly settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.

E. Paint shall arrive on the job color-mixed except for tinting of under-coats and possible thinning.

F. All thinning and tinting materials shall be as recommended by the manufacturer for the particular material thinned or tinted.

G. It shall be the responsibility of the Contractor to see that all mixed colors match the color selection made by the Architect prior to application of the coating.

2.4 SCHEDULE OF FINISHES

A. High Performance Coating on Exterior Galvanized Ferrous Metals

First Coat:	"PittGuard Rapid Coat Epoxy 95-245 Series by PPG, "Series 27WB Typoxy" by Tnemec; "Epoxy Mastic Coating V 160" by Benjamin Moore Corotech or "Recoatable Epoxy Primer 867-45" by Sherwin Williams.
Second Coat:	"Pittthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1080 (gloss) Endura-Shield WB" or "Series 1081 (semi-gloss) Endura-Shield WB" by Tnemec; "Acrylic Aliphatic Urethane V 500 (Gloss)" or "V 510 (Semi-Gloss)" by Benjamin Moore Corotech or "Hi-Solids Urethane B65-300/350" by Sherwin Williams.

B. High Performance Coating on Exterior Non-Galvanized Ferrous Metals

Prime Coat:	"Amercoat 68HS Epoxy Zinc-Rich Primer" by PPG; "Series 94-H_2O Hydro-Zinc" by Tnemec; "Organic Zinc Rich Primer V 170" by Benjamin Moore Corotech or "Zinc Clad II Plus Inorganic Zinc Rich Coating B69V212" by Sherwin Williams.
Second Coat:	"Pitt Guard Rapid Coat Epoxy 95-245" by PPG; "Series 27WB Typoxy" by Tnemec; "Epoxy Mastic Coating V 160" by Benjamin Moore Corotech or "Macropoxy 646 Fast Cure Epoxy B58-600" by Sherwin Williams.

Third Coat: "Pitthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1070V (gloss) Fluoronar" or "Series 1071V (semi-gloss) Fluoronar" by Tnemec; "Acrylic Aliphatic Urethane V 500 (Gloss)" or "V 510 (Semi-Gloss)" by Benjamin Moore Corotech or "Hi-Solids Polyurethane B65-300/350" by Sherwin Williams.

C. Interior Ferrous Metal

Satin Finish/Latex

Primer: Benj. Moore Ultra Spec HP Acrylic Metal Primer (HP04)
PPG Pitt Tech Plus DTM Acrylic Primer 4020
Sherwin-Williams Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt Glaze WB1 Pre-Catalyzed Eggshell Epoxy 16-310
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series

Second Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt Glaze WB1 Pre-Catalyzed Eggshell Epoxy 16-310
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series

a. Total DFT not less than: 3.9 mils

Semi-Gloss Finish/Latex

Primer: Benj. Moore Ultra Spec-HP Acrylic Metal Primer (HP04)
PPG Devflex 4020 PF DTM Primer/Flat Finish
Sherwin-Williams Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt Glaze WB1 Pre-Catalyzed Semi-Gloss Epoxy 16-510
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series

Second Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt Glaze WB1 Pre-Catalyzed Semi-Gloss Epoxy 16-510
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series

a. Total DFT not less than: 4.0 mils

D. Interior Concrete Block

Flat Finish/Vinyl Acrylic Latex over Filler

Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150

First Coat: Benj. Moore Ultra Spec 500 Interior Flat Latex (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series

Second Coat: Benj. Moore Ultra Spec 500 Interior Flat Latex (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series

a. Total DFT not less than: 10.7 mils

Eggshell Finish/Vinyl Acrylic Latex Over Filler

Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150

First Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)

PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eggshell, B20-1900 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eggshell, B20-1900 Series
a. Total DFT not less than: 10.9 mils

Semi-Gloss Finish/Vinyl Acrylic Latex over Filler
Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Gloss (N540)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI Series
S-W ProMar 200 Zero VOC Interior Latex S. Gloss, B31-2600 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Gloss (N540)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI Series
S-W ProMar 200 Zero VOC Interior Latex S. Gloss, B31-2600 Series
a. Total DFT not less than: 10.7 mils

E. Interior Drywall

Flat Finish/Vinyl Acrylic Latex
Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600
First Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series
Second Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series
a. Total DFT not less than: 3.6 mils

Eggshell Finish/Vinyl Acrylic Latex
Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shell, B20-1900 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shell B20-1900 Series
a. Total DFT not less than: 3.8 mils

F. Primer for Fiberglass Faced Drywall:

1 coat Benjamin Moore 046 Fresh Start Acrylic Superior Primer
1 coat PPG Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI
1 coat Pratt & Lambert "Suprime" Interior Latex Enamel Undercoater Z1013/F1013
1 coat Sherwin Williams "Builders Solution."

G. Interior Painted Wood

Satin Finish/Latex
Primer: Benj. Moore Advance Waterborne Int. Alkyd Primer (790)
PPG Seal Grip Interior Primer/Finish 17-951
S-W Multi-Purpose Latex Primer/Sealer B51 Series
First Coat: Benj. Moore Advance Waterborne Int. Alkyd Satin (792)
PPG Speedhide Zero Interior Latex Satin, 6-4410XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
Second Coat: Benj. Moore Advance Waterborne Int. Alkyd Satin (792)
PPG Speedhide Zero Interior Latex Satin, 6-4410XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
a. Total DFT not less than: 4.0 mils

Semi-Gloss Finish/Latex
Primer: Benj. Moore Advance Waterborne Int. Alkyd Primer (790)
PPG Seal Grip Interior Primer/Finish 17-951
S-W Multi-Purpose Latex Primer/Sealer B51 Series
First Coat: Benj. Moore Advance Waterborne Int. Alkyd (793)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI
S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series
Second Coat: Benj. Moore Advance Waterborne Int. Alkyd (793)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI
S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series
a. Total DFT not less than: 3.8 mils

H. Concrete Floor Paint

Primer: Corotech V155 Solid Epoxy Pre-Primer
First Coat: Corotech V440 Waterborne Amine Epoxy
Second Coat: Corotech V440 Waterborne Amine Epoxy
Non-Slip Aggregate: Broadcast Corotech V630 Anti-Slip Aggregate

I. Concrete Floor Sealer: "Super Diamond VOX" water-based, low-VOC acrylic sealer, as manufactured by Euclid Chemical Company, or approved equal.

2.5 PIPING AND MECHANICAL EQUIPMENT EXPOSED TO VIEW

A. Paint all exposed piping, conduits, ductwork and mechanical and electrical equipment. Use heat resisting paint when applied to heating lines and equipment. The Contractor is cautioned not to paint or otherwise disturb moving parts in the mechanical systems. Mask or otherwise protect all parts as required to prevent damage.

B. Exposed Uncovered Ductwork, Piping, Hangers and Equipment: Latex Enamel Undercoater and one (1) coat Acrylic Latex Flat.

C. Exposed Covered Piping, Duct Work and Equipment: Primer/Sealer and one (1) coat Acrylic Latex Flat.

D. Panel Boards, Grilles and Exposed Surfaces of Electrical Equipment: Latex Enamel Undercoater and two (2) coats Latex Semi-Gloss.

E. Equipment or Apparatus with Factory-Applied Paint: Refinish any damaged surfaces to match original finish. Do not paint over name plates and labels.

F. All surfaces of insulation and all other work to be painted shall be wiped or washed clean before any painting is started.

G. All conduit, boxes, distribution boxes, light and power panels, hangers, clamps, etc., are included where painting is required.

H. All items of Mechanical and Electrical trades which are furnished painted under their respective Contracts shall be carefully coordinated with the work of this Section so as to leave no doubt as to what items are scheduled to be painted under this Section.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL WORKMANSHIP REQUIREMENTS

A. Only skilled mechanics shall be employed. Application may be by brush or roller. Spray application only upon acceptance from the Architect in writing.

B. The Contractor shall furnish the Architect a schedule showing when it is expected that the respective coats of paint for the various areas and surfaces will have been completed. This schedule shall be kept current as the job progresses.

C. The Contractor shall protect his work at all times and shall protect all adjacent work and materials by suitable covering or other method during progress of painting and finishing work. Upon completion of the work, Contractor shall remove all paint and varnish spots from floors, glass and other surfaces, and shall remove from the premises all rubbish and accumulated materials of whatever nature not caused by others, and leave all painting and finishing work in clean, orderly, and acceptable condition.

D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide ample in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

E. Remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.

F. All materials shall be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.

G. Coverage and hide shall be complete. When color, stain, dirt or undercoats show through final coat of paint, the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Owner.

H. All coats shall be dry to manufacturer's recommendations before applying succeeding coats.

I. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.3 PREPARATION OF SURFACES

A. General

1. The Contractor shall be held entirely responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished shall be completely dry, clean and smooth.

2. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Metal Surfaces

1. Weld Fluxes: Remove weld fluxes, splatters, and alkali contaminants from metal surfaces in an approved manner and leave surface ready to receive painting.

2. Bare Metal: Thoroughly clean off all foreign matter such as grease, rust, scale and dirt before priming coat is applied. Clean surfaces, where solder flux has been used, with benzene. Clean surfaces by flushing with mineral spirits. For aluminum surfaces, wipe down with an oil free solvent prior to application of any pre-treatment.

a. Bare metal to receive high performance coating specified herein must be blast cleaned SSPC SP-6 prior to application if field applied primer; coordinate with steel trades furnishing ferrous metals to receive this coating to insure that this cleaning method is followed.

3. Shop Primed Metal: Clean off foreign matter as specified for "Bare Metal." Prime bare, rusted, abraded and marred surfaces with approved primer after proper cleaning of surfaces. Sandpaper all rough surfaces smooth.

4. Galvanized Metal: Prepare surface as per the requirements of ASTM D 6386.

5. Metal Filler: Fill dents, cracks, hollow places, open joints and other irregularities in metal work to be painted with an approved metal filler suitable for the purpose and meeting the requirements of the related Section of work; after setting, sand to a smooth, hard finish, flush with adjoining surface.

C. Gypsum Drywall Surfaces: Scrape off all projections and splatters, spackles all holes or depressions, including taped and spackled joints, sand smooth. Conform to standards established in Section 092900, "Gypsum Drywall."

D. Wood Surfaces: Sand to remove all roughness, loose edges, slivers, or splinters and then brush to remove dust. Wash off grease or dirt with an approved cleaner. Fill all cracks, splits, nail holes, screw holes, and surface defects with putty after the priming coat has been applied.

Putty shall be brought up flush with the surface and sanded smooth and touched-up with primer when dry.

E. Block Masonry Surfaces: Thoroughly clean off all grit, grease, dirt, mortar drippings or splatters, and other foreign matter. Remove nibs or projections from masonry surfaces. Fill cracks, holes or voids not filled under the "Masonry" Section, with Portland cement grout, and bag surface so that it has approximately the same texture as the adjacent masonry surface.

F. Testing for Moisture Content: Contractor shall test all masonry and drywall surfaces for moisture content using a reliable electronic moisture meter. Contractor shall also test latex type fillers for moisture content before application of top coats of paint. Do not apply any paint or sealer to any surface or to latex type filler where the moisture content exceeds seven (7) percent as measured by the electronic moisture meter.

G. Touch-Up: Prime paint all patched portions in addition to all other specified coats.

3.4 MATERIALS PREPARATION

A. Mix and prepare painting materials in strict accordance with the manufacturer’s directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

C. Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

D. Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Tint undercoats to match the color of the finish coat; provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.5 APPLICATION

A. General

1. Apply paint by brush or roller in accordance with the manufacturer’s directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required.

2. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the coating manufacturer’s directions.

3. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

    a. "Exposed surfaces" is defined as those areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, etc., are in place in areas scheduled to be painted.

5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint, before final installation of equipment.

6. Paint the back sides of access panels, removable or hinged covers to match the exposed surfaces.

7. Finish doors on tops, bottoms, and side edges the same as the faces, unless otherwise indicated.

8. Enamel finish applied to wood or metal shall be sanded with fine sandpaper and then cleaned between coats to produce an even surface.

9. Paste wood filler applied on open grained wood after beginning to flatten, shall be wiped across the grain of the wood, then with a circular motion, to secure a smooth, filled, clean surface with filler remaining in open grain only. After overnight dry, sand surface with the grain until smooth before applying specified coat.

B. Scheduling Painting

1. Apply the first coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not re-coat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Prime Coats: Re-coat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

D. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.

E. Touching-Up of Factory Finishes: Unless otherwise specified or shown, materials with a factory finish shall not be painted at the project site. To touch up, the Contractor shall use the factory finished material manufacturer's recommended paint materials to repair abraded, chipped, or otherwise defective surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damages by cleaning, repairing or replacing, and repainting, as acceptable to the Architect.

B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.7 CLEAN UP

A. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 101400 - SIGNAGE

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the signage as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Room identification signs.
2. Interior directional and door signage.
3. Fire egress, floor, and other signs required by Code.
4. Fabricated metal letters for building signage.

1.3 RELATED SECTIONS

A. Exit signs - Division 26.

1.4 QUALITY ASSURANCE

A. For actual installation of the interior panel signs, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the required skills.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

B. Samples: Submit samples of each sign showing finishes, colors, surface textures and qualities of manufacture and design of each sign component, including graphics.

C. Shop Drawings: Submit shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale details of sign wording and lettering layout. Show anchorage and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 PANEL SIGNS

A. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally from corner to corner, manufactured from aluminum, unframed. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, of letters, numbers, and other graphic devices.

C. Tactile Characters: Characters and Grade 2 Braille raised 1/32" above surfaces, in contrasting color.

2.2 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures, or other characteristics related to appearance, provide colors and surface textures as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where signage is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install units and components at the locations directed by the Architect, securely mounted with concealed theft-resistant fasteners. Attach to substrates in accordance with the manufacturer's instructions.

B. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 102113 - TOILET PARTITIONS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the toilet partitions and urinal screens as shown on the drawings and/or specified herein, including, but not necessarily limited to the following:

1. Floor-anchored, overhead-braced, solid phenolic toilet partitions.

2. Wall-hung urinal screens.

3. Hardware and accessories.

1.3 RELATED SECTIONS

A. Ceramic Tiling - Section 093013.

B. Toilet Accessories - Section 102813.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to fabrication to ensure proper fitting of the work.

B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be built into other work for the installation of toilet partitions and related work. Coordinate delivery with other work to avoid delay.

1.5 SUBMITTALS

A. Shop Drawings: Before any of the materials of this Section are delivered to the job site, submit the following:

1. Room layouts and elevations for all areas, with dimensions based on actual dimensions taken at site.

2. Materials, finishes, details of construction, gauges of metal, hardware, fastening and anchoring conditions and relation to adjoining construction.

B. Samples - Submit:

1. Solid phenolic panel, each color – 300mm x 300mm.

2. All hardware and fitting items and fastenings for same. Include all items listed under 2.2 C. below.

C. Templates: Submit templates to other trades as required for support of toilet partitions.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Type and Manufacturer: Toilet compartment shall be floor-anchored, overhead-braced solid-phenolic assemblies with non-corrosive doors, panels, and pilasters equal to "Duraline Series," with continuous gap-free stile and door interlocking hardware, by Bobrick Washroom Equipment, Inc., or equivalent by Bradley Corp., Metpar Corp., or approved equal.

B. Type: Provide wall-hung urinal screens of same material as toilet partitions.

2.2 MATERIALS AND COMPONENTS

A. Panels, doors, and pilasters shall be fabricated from solid phenolic material constructed of solidly fused plastic laminate with matte finish melamine surfaces, colored face sheets, and black phenolic-resin core that are integrally bonded. Edges shall be black. Brown edges shall not be acceptable. Color and pattern as selected by Architect from manufacturer's full range of colors.

B. Solid phenolic material shall meet National Fire Protection Association Class A, Uniform Building Code Class I, ASTM E 84 Fire Resistance Standards; flame spread 20, smoke density 95.

C. Finish Thickness

1. Stiles and Doors: 19mm.

2. Panels: 13mm.

D. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge stainless steel with satin finish; 25mm x 39mm inches x 1450mm inches high.

E. Stiles: Floor-Anchored stiles furnished with expansion shields and threaded rods.

1. Leveling Devices: 7 gauge, 3/16 inches thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.

2. Stile Shoes: One-piece, 22 gauge, 18-8, Type 304 stainless steel, 4 inch height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch or 1 inch stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

F. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 055000.

G. Hardware:

1. Compliance: Operable with one hand, without tight grasping, pinching, or twisting of the wrist, and force to operate does not exceed five pounds.

2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment.

3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish. Chrome-plated "Zamak," aluminum, or extruded plastic hardware not acceptable.

4. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.

    a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb. per insert.

5. Clothes Hooks: Projecting no more than 28mm inch from face of door.

6. Mounting: Hinges, keepers, latches, clothes hooks and their fasteners concealed inside compartment. Exposed hinges, keepers, latches, clothes hooks and their fasteners on exterior of compartment not acceptable with the exception of accessible compartments.

7. Hardware Type: Institutional hardware (G.67).

    a. Provide gap free stile and door interlocking panels
    b. Latching: 14 gauge sliding door latch, 11 gauge keeper; latch slides on shock-resistant nylon track. Twist-style door latch operation not acceptable.
    c. Hinges: 16 gauge stainless steel with satin finish, self-closing, 3 section hinges.
    d. Mounting Brackets: 18 gauge stainless steel and extend full height of panel.
        1). U-Channels: Secure panels to stiles.
        2). Angle Brackets: Secure stiles-to-walls and panels-to-walls.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where floor mounted overhead braced toilet partitions are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install work of this Section in a rigid and permanent manner, straight and plumb, with all horizontal lines level.

B. Install panels and doors 350mm above finished floor, unless otherwise indicated. Toilet compartment doors shall be centered on water closets, unless otherwise indicated.

C. Maintain uniform clearance of approx. 12mm between pilasters and panels, and 12mm between pilasters or panels and finished wall.

D. Maintain uniform clearance of 6mm or less between vertical edges of doors and pilasters.

E. Set pilaster units with anchorages having not less than 50mm penetration into structural floor. Level, plumb, and tighten installation with devices furnished. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.

END OF SECTION

SECTION 102213 - WIRE MESH PARTITIONS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the wire mesh partitions as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

1.4 QUALITY ASSURANCE

A. Provide products of the standard best quality for the particular kind of material specified.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's latest published literature for approval. Obtain approval before materials are delivered to the job site.

B. Submit installation shop drawings for locations as indicated on the contract drawings. Shop drawings shall indicate elevations, sections, methods of anchoring and connecting to surrounding construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Avoid damage to items during transit and delivery. Do not set work damaged in transit; replace with undamaged material without additional cost to the Owner.

B. A space at the building shall be designated for the storage of material provided under this Section. The responsibility for all such material shall, however, rest entirely with the Contractor until it has been set and accepted as complete in accordance with the Contract requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wire mesh partitions of height and layout as shown on the Drawings shall be:

1. WireCrafters Style 840 or manufacturer as listed below:

2. Miller Wire Works, Inc.

3. Acorn Wire and Iron Works, Inc.

4. The G/S Co.

2.2 MATERIALS

A. Wire Mesh Partitions

1. Mesh: 1-1/2" diamond-intermediate crimped.

2. Wire: No. 10 W & M gauge, 0.135 steel wire woven inot a 2 by 1 inch rectangular mesh.

3. Vertical Channel: 1-1/4" x 5/8" "C" Type with 1/4" bolts.

4. Horizontal Channel: 1" x 1/2".

5. Center Reinforcement: Double: Two 1" x 1/2" CCR channel bolted each side of mesh.

6. Corner Post: 1-3/4" x 1-3/4" x 1/8" angle.

7. Top Reinforcement: 2-1/4" x 1" Channel: Fastened with 1/4" "U" bolts. Approximately 24" on center.

8. Floor Sockets: 1-1/4" x 1-1/4" x 2-1/2" high-ductile iron (weldable).

9. Swinging Door Frame: 1-1/4" x 1/2" channel.

10. Hardware: Mortise type lock operated by key outside, recess knob inside.

B. Finish

1. Fabricated units shall be dipped in a cleaning bath.

2. Units shall be polyester powder coated and air dried.

3. Color shall be as selected by the Architect from manufacturer's standard colors.

C. Bracing: Free standing partitions shall have 3" channel line posts approximately 15'-0" on center with 9" x 18" x 5/16" base plates.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where wire mesh partitions are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. All work is to be executed by skilled mechanics and shall be of the finest quality, neat in appearance and free from defects.

B. Installation shall be made in strict accordance with manufacturer's recommendations, plumb, and true to line and level. Anchor partitions firmly to floor and adjacent masonry walls.

3.3 ADJUST AND CLEAN

A. Clean and leave free from blemishes, defects, and dirt.

B. Replace any damaged units at no change in Contract Price.

C. Adjust hardware for maximum efficiency.

END OF SECTION

SECTION 102813 - TOILET ACCESSORIES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the toilet accessories as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Mirrors.
2. Grab bars.
3. Electric hand dryers.
4. Diaper-changing stations.
5. Additional toilet accessories as scheduled on the drawngs.
6. Shelf and hook strip for Janitor's Closets.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Gypsum Drywall - Section 092900.

C. Ceramic Tiling - Section 093013.

D. Toilet Partitions - Section 102113.

E. Electrical - Division 26.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units. Accessories shall be installed at heights in compliance with prevailing Handicapped Code.

C. Products: Unless otherwise noted, provide products of same manufacturer for each type of unit and for units exposed in same areas.

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 SUBMITTALS

A. Product Data: Submit manufacturer's technical data, catalog cuts and installation instructions for each toilet accessory.

B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

C. Submit schedule of accessories indicating quantity and location of each item.

1.6 PRODUCT HANDLING

A. Deliver accessories to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type or material, manufacturer's name and brand name. Delivered materials shall be identical to approved samples.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 240 or ASTM A 666, Type 304, with polished No. 4 finish, 22 gauge minimum, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Galvanized Steel Sheet: ASTM A 653, G60.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirrors: ASTM C 1503, mirror glazing quality, clear glass mirrors, nominal 1/4" thick.

2.2 FASTENING DEVICES

A. Exposed Fasteners: Theft-proof type, chrome plated, or stainless steel; match finishes on which they are being used.

B. Concealed Fasteners: Galvanized (ASTM A 123) or cadmium plated.

C. No exposed fastening devices permitted on exposed frames.

D. For metal stud drywall partitions, provide ten (10) gauge galvanized sheet concealed anchor plates for securing surface mounted accessories.

2.3 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted. Unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

B. Surface-Mounted Toilet Accessories, General: Fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage.

C. Recessed Toilet Accessories, General: Fabricate units of all welded construction, without mitered corners. Hang doors of access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

D. Diaper-Changing Table: As manufactured by Koala Kare products, Division of Bobrick; recessed-mounted horizontal unit that opens by folding down from stored position and with child-protection strap. Diaper-changing table shall be engineered to support a minimum of 250 lb. static load when opened.

2.4 MANUFACTURERS

A. Provide products manufactured by Bobrick Washroom Equipment Co., American Specialties, Inc., Bradley Corp., A & J Washroom Accessories, or approved equal.

2.5 ACCESSORY SCHEDULE

A. Refer to drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where toilet accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Accessories that are to be partition mounted shall be closely coordinated with other trades, so that the necessary reinforcing is provided to receive the accessories.

B. Furnish templates and setting drawings and anchor plates required for the proper installation of the accessories at gypsum drywall and masonry partitions. Coordinate the work to assure that base plates and anchoring frames are in the proper position to secure the accessories.

C. Verify by measurements taken at the job site those dimensions affecting the work. Bring field dimensions that are at variance with those on the approved shop drawings to the attention of the Architect. Obtain decision regarding corrective measures before the start of fabrication of items affected.

D. Cooperate in the coordination and scheduling of the work of this Section with the work of other Sections so as not to delay job progress.

3.3 INSTALLATION

A. Install accessories at locations indicated on the drawings, using skilled mechanics, in a plumb, level and secure manner.

B. Concealed anchor assemblies for gypsum drywall partitions shall be securely anchored to metal studs to accommodate accessories. Assemblies shall consist of plates and/or angles tack welded to studs.

C. Secure accessories in place, at their designated locations by means of theft-proof concealed set screws, so as to render removing of the accessory with a screwdriver impossible.

D. Unless otherwise indicated, accessories shall conform to heights from the finished floor as shown on the drawings. Where locations are not indicated, such locations shall be as directed by the Architect.

E. Installed accessories shall operate quietly and smoothly for use intended. Doors and operating hardware shall function without binding or unnecessary friction. Dispenser type accessories shall be keyed alike. Prior to final acceptance, master key and one duplicate key shall be given to Owner's authorized agent.

F. The Architect shall be the sole judge of workmanship. Workmanship shall be of the highest quality. Open joints, weld marks, poor connections, etc., will not be permitted. The Architect has the right to reject any accessory if he feels the workmanship is below the standards of this project.

G. Grab bars shall be installed so that they can support a three-hundred (300) lb. load for five minutes per ASTM F 446.

3.4 CLEANING AND PROTECTION

A. Upon completion of the installation, clean accessories of dirt, paint and foreign matter.

B. During the installation of accessories and until finally installed and accepted, protect accessories with gummed canvas or other means in order to maintain the accessories in acceptable condition.

C. Replace and/or repair, to the Owner's satisfaction, and at no additional cost to the Owner, installed work that is damaged or defective.

END OF SECTION

SECTION 104416 - FIRE EXTINGUISHERS AND CABINETS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the fire extinguishers and cabinets as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Fire suppression systems - Division 21.

C. Fire hose cabinets and valve cabinets - Division 21.

1.4 QUALITY ASSURANCE

A. Provide portable fire extinguishers, cabinets and accessories by one manufacturer.

B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Where color selections by Architect are required, include color charts showing full range of manufacturer's standard colors and designs available.

B. Samples: Submit samples, 6" square, of each required finish. Prepare samples on metal of same gauge as metal to be used in the work. Where normal color variations are to be expected, include 2 or more units in each sample showing the limits of such variations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

1. JL Industries.

2. Larsen's Mfg. Co.

3. Potter Roemer.

2.2 EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

B. Abbreviations indicated below to identify extinguisher type related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

C. Multi-Purpose Dry Chemical Type: UL rated 2-A:10-B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.3 MOUNTING BRACKETS

A. Provide manufacturer's standard bracket designed to prevent accidental dislodgment of extinguisher, of proper size for type and capacity of extinguisher specified, in manufacturer's standard enamel finish; color to match extinguisher.

2.4 CABINETS

A. Type and Style: Fire extinguisher cabinets shall be heavy gauge baked white enamel box, extruded aluminum door and trim, semi-recessed or surface mounted, with 1/8 inch thick clear acrylic panel, sized to fit within the partition or wall depth.

1. Door Style: Vertical Duo.

2. Identification: Die-cut lettering spelling "FIRE EXTINGUISHER" on door.

3. Aluminum Finish: Satin anodized.

4. Mounting: Surface mounted on masonry walls, semi-recessed in all stud wall construction.

B. Basis for Project Design: Larsen’s "Model AL-2409-5R" and "Model AL-2409-SM."

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where fire extinguishers and cabinets are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install items included in this Section in locations indicated and at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

B. Where exact location of cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by the Architect.

3.3 SERVICE

A. Determine the approximate completion date of the work and then inspect, charge, and tag the fire extinguishers at a date not more than 10 days before or not less than one day before actual completion date of the work.

END OF SECTION

SECTION 105113 - LOCKERS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the lockers as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Single-tier (full-height) metal lockers in Locker Rooms.
2. Double-tier metal lockers in First Floor Toilet Rooms.
3. Lockers room benches.
4. Installation only of handgun lockers.

1.3 QUALITY ASSURANCE

A. Qualifications of Installers: For installation of lockers, use only personnel who are thoroughly trained and experienced in the skills involved and who are completely familiar with the manufacturer's recommended methods of installation.

B. Uniformity: Provide each locker and bench as produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.

C. Take field measurements prior to fabrication.

1.4 SUBMITTALS

A. Product Data: Submit complete manufacturer's technical data and installation instructions.

B. Shop Drawings: Before any materials of this Section are delivered to the job site, submit complete shop drawings, technical data and installation instructions to the Architect. Shop drawing must show method of installation, fillers, trim and accessories. Include locker sequencing information.

C. Samples: Submit 6" x 6" samples of manufacturer's standard finish.

1.5 PRODUCT HANDLING

A. Do not deliver lockers until building is enclosed and spaces to receive lockers are clean and dry.

B. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide steel lockers manufactured by American Locker Security Systems, Inc., Interior Steel Equipment Co., Lyons Metal Products, or approved equal meeting these specifications.

2.2 MATERIALS

A. Sheet Steel: Mild cold-rolled and leveled steel, free from buckle, scale, and surface imperfections.

B. Fasteners: Cadmium-, zinc-, or nickel-plated steel or stainless steel.

1. Exposed Bolt Heads: Tamperproof type.

2. For fastening moving parts, use self-locking nuts or lock washers.

C. Equipment: Hooks of cadmium-plated or zinc-plated steel.

2.3 FABRICATION, GENERAL

A. Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make all exposed metal edges safe to touch. Weld or rivet connections; bolted connections not permitted. Grind exposed welds flush. Do not expose rivet heads on fronts of locker doors or frames.

B. Finishing: Chemically pretreat metal with degreasing and phosphatizing process. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plates and non-ferrous metal.

1. Color: Provide locker units in color(s) as selected by Architect from manufacturer's standards. Concealed parts may be manufacturer's standard neutral color.

2.4 LOCKERS

A. Locker Sizes

1. Double-Tier Lockers: 18 inches wide by 36 inches high by 24 inches deep.

2. Single-Tier Lockers: 18 inches wide by 72 inches high by 24 inches deep.

B. Door Frames: Frames shall be 16 gauge formed in a channel shape. Vertical members shall have additional flange to provide a continuous door strike. Cross frame members shall also be 16-gauge channel shaped, including intermediate cross frames on double and triple tier lockers.

C. Body: Bottoms shall be 16 gauge. Tops, sides, backs, and shelves shall be 24 gauge. Bolt spacing shall not exceed 9" o.c.

D. Doors: Doors shall be 16 gauge, with louvers for ventilation; channel shaped on both the lock and hinge side, with angle formations across the top and bottom. Fabricate to swing 180 degrees.

1. Ventilation: Provide stamped, louvered vents in door face, as follows:

    a. Single-Tier Lockers: Not fewer than 6 louver openings top and bottom.
    b. Double-Tier Lockers: Not fewer than 3 louver openings top and bottom.

2. Hinges: Steel, full-loop, 5-knuckle, tight pin. Weld to inside of frame and secure to door with no fewer than 2 factory-installed fasteners that are completely concealed and tamperproof when door is closed.

    a. Provide at least 3 hinges per door over 42 inches high; at least 2 hinges per door 42 inches high or less.

E. Projecting Handle and Latch: Positive automatic, prelocking, pry-resistant latch and pull with rubber silencers; chromium-plated, heavy-duty, vandal-proof lift-up handle, containing strike and eye for padlock; and with latching action as follows:

1. Single-Tier Lockers: Not less than 3-point latching.

2. Double-Tier Lockers: Not less than 2-point latching.

F. Locker Accessories:

1. Equipment: Furnish each locker with the following items:

    a. Single-tier lockers: Hat shelf, hanger rod, and not fewer than 2 single-prong wall hooks.
    b. Double-tier lockers: Hanger rod and not fewer than 2 single-prong hooks.

2. Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 3/8 inch high. Number lockers in sequence as directed by the Architect. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plates.

3. Base.

2.5 LOCKER ROOM BENCHES

A. Manufacturer's standard units with laminated hardwood tops approx. 9-1/2" wide by 1-1/2" thick, in lengths as indicated. Furnish steel pedestal supports not more than 6'-0" o.c., with provisions for concealed fastening to floor and securing to bench. Furnish all anchorages. Apply manufacturer's standard clear coating to bench tops and baked enamel finish to pedestals.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where lockers are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid and flush installation.

B. Space fastenings 36" o.c. and apply through back-up reinforcing plates where necessary to avoid metal distortion; conceal all fasteners.

C. Install trim, sloping top units, and metal filler panels using concealed fasteners to provide flush, hairline joints against adjacent surfaces.

D. Install benches to comply with manufacturer's instructions in such a manner that they resist a 200 lb. load applied laterally to benches.

3.3 ADJUST AND CLEAN

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Touch-up marred finishes; replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 111200 - PARKING CONTROL EQUIPMENT

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the parking control equipment as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Automatic barrier gates.
2. Vehicle detectors.
3. Card control units.
4. Wheel stops.
5. Safety mirrors.
6. Clearance bars.
7. Corner guards.
8. Bollards.
9. Pavement markings.

1.3 SUBMITTALS

A. Product Data: For each item of parking control equipment. Include manufacturer's standard details and installation and maintenance instructions.

B. Shop Drawings: For each item of parking control equipment. Include plans, elevations, and details of typical members and other components. Show layout and installation details, including anchorage details.

1. Wiring Diagrams: Detail wiring for parking control equipment operator, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

    a. Show locations of connections to electrical service provided in other Sections.

C. Maintenance Data: For parking control equipment components to include in the maintenance manuals specified in Division 1.

D. Maintenance Instructions: Manufacturer's written instructions for maintenance of parking control equipment.

1. Include recommended methods and frequency for maintaining equipment in optimum operating condition under anticipated traffic and use conditions.

2. Include precautions against materials and methods that may be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the parking control equipment manufacturer for both installation and maintenance of the type of units required for this Project, and whose installations have resulted in construction with a record of successful in-service performance.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Source Limitations: Obtain parking control equipment through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of each parking control equipment component and are based on the specific type and model indicated. Other manufacturer's individual components with equal performance characteristics may be considered provided deviations in dimensions and profiles are minor and do not change design concept.

1. Do not modify intended design concept, as judged solely by Architect, except with Architects approval and only to extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Listing and Labeling: Provide internal electrical components required as part of parking control equipment specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Gate Arms: Two replacement breakaway gate arms for each gate installed. Include required accessory components.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum manufacturer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required.

1. Extruded Aluminum: ASTM B 221, 6063-T6.

2. Aluminum Sheet: ASTM B 209, 5005-H15.

3. Aluminum Floor Plate: ASTM B 632, 6061.

B. Cold-Rolled Steel Sheet: ASTM A 366.

C. Galvanized Steel Floor Plate: ASTM A 786, hot-dip galvanized according to ASTM A 123.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; commercial quality.

E. Steel Structural Tubing: ASTM A 500, cold-formed steel structural tubing, Grade B.

F. Steel Mechanical Tubing: ASTM A 513, welded steel mechanical tubing.

1. Hot-Dip Galvanized: According to ASTM A 123.

G. Stainless Steel Sheet: ASTM A 666, Type 302 or 304.

2.2 AUTOMATIC BARRIER GATES

A. General: Provide UL-approved, automatic, barrier-gate parking control system.

B. Cabinets: Fabricate cabinets of 0.0966" thick steel sheet or 0.125" sheet aluminum, internally reinforced. Weld seams and grind smooth. Provide weatherproof, gasketed access doors with flush-mounted locks; furnish two keys for each gate, keyed alike.

1. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel finish over primer system.

C. Gate Arm: Fabricate gate arm of galvanized steel shapes, as detailed on the drawings. Finish with high-performanc coating system as specified in Section 099000. Provide a mounting flange with breakaway feature to ensure a clean break if arm gets struck.

1. Reversing Feature: Provide an automatic instant-reversing mechanism that stops downward motion of gate arm if arm strikes an object and that immediately returns arm to upward position. Include a 0- to 60-second variable-time reset device.

D. Operator: Provide 1/3-hp; 115-V, ac; 60-Hz; single-phase; instant-reversing motor for operating gate arm. Transmit power to gate-arm drive shaft through a harmonic-acting crank and connecting rod. Fabricate cranks, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.

E. Electrical Components: Provide electrical control components in factory-sealed, plug-in controller. Provide a galvanized steel box for wiring connections. Equip unit with the following features:

1. One 115 V, ac grounded convenience outlet.

2. 250 W strip heater with a control switch and a preset thermostat.

3. On-off switch.

4. Automatic-manual switch.

5. Overload switch protection.

2.3 VEHICLE DETECTORS

A. Vehicle Detection: For use in temperature range of -40 to 160 °F to consist of detector unit in conjunction with sensing loop to activate barrier gate when vehicle enters or exits.

B. Loop Detectors: Solid-state, electronic vehicle-detector units designed to detect presence or transit of a vehicle over an embedded loop of wire and emit an electrical pulse to operate other equipment. Provide a three-position sensitivity switch and detection indicator light on front panel.

1. Detector Loops: Multiple strands of wire of the wire size, number of turns, loop size, and method of placement as recommended in writing by parking control equipment manufacturer.

C. Presence Detectors: Self-contained scanner detectors consisting of an infrared presence-sensing device to activate gate operator and a horizontal photoelectric beam to prevent gate from closing until traffic is clear. Detection patterns and sensitivity shall be adjustable.

2.4 CARD CONTROL

A. General: Provide pedestal mounted card control units to activate barrier entrance gate.

B. Control Unit: To activate gate arm by insertion of coded card, security code, or key fob; "ProxPro" as manufactured by HID Global Corporation, Austin, TX.

C. Card Reader Housing:

1. Mount housing on a 2-inch square steel tube pedestal with a curved top to receive housing, and a trim plate to cover anchor bolts.

2. Finish exterior of pedestal and housing with manufacturer’s standard baked enamel finish over primer. Color as determined after review of manufacturer’s standard colors.

D. Card Reader: Mount 46 inches above vehicle pavement surface, protect with projecting weather shield.

2.5 PRECAST WHEEL STOPS

A. Provide 6' Hex, Part No. 10551-000 car stops as manufactured by TransLine Industries, Inc., or approved equal; 3500 psi air entrained precast concrete car stops with absorption rates not exceeding 5% and smooth finish. Stops shall be 6'-0" long, 7" wide by 7" high and reinforced with two 7/8" diameter deformed bars conforming to ASTM A 615, grade 60. Stops shall be anchored with three (3) 1-1/4" diameter galvanized steel pipe, 2'-0" long. Concrete materials shall conform to the requirements of Section 033000.

2.6 CONVEX DETECTABLE MIRRORS

A. Safety Mirror: Convex acrylic lens and mounting hardware with adjustable swivels and steel mounting brackets.

B. Mounting: Ceiling mounted.

C. Acceptable Product: Model P38WP H113361 Convex Circular Mirror by Roadtech Manufacturing, or approved equal.

2.7 CLEARANCE BARS

A. Polyethylene thermoplastic, 6" diameter, 8'-0" length.

2.8 CORNER GUARDS

A. Provide rubber corner guards where shown, PAW-31 as manufactured by Traffic Safety Zone, square, 31-1/2" long x 4" wide x 3/8" thick. Set and adjust guards to finish flush with adjacent surfaces.

2.9 BOLLARDS

A. Steel Bollards: Provide six (6) inches O.D. extra strong (Schedule 80) steel pipe, concrete filled, with base of steel plate for mounting to anchor bolts in concrete foundation. Rabbet top of steel pipe and insert 1/4" steel plate cap, flush with top of pipe. Weld top of cap to pipe and grind smooth and flush.

2.10 PAVEMENT MARKINGS

A. Pavement Marking Paint: Factory-mixed, quick-drying non-bleeding paint specifically formulated for marking asphaltic concrete surfaces, white color equal to "Setfast Acrylic Waterborne Traffic Marking Paint (TM226)" made by Sherwin Williams or approved equal.

B. Pavement Marking Equipment: Provide spray machines specifically designed for pavement marking.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before installation, examine areas to receive parking control equipment. Verify that critical dimensions are correct and conditions are acceptable.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide templates for anchor bolts and other items encased in concrete or below finished surfaces so as not to delay the Work.

3.3 INSTALLATION

A. General: Install parking control equipment according to manufacturer's written instructions and placement drawings.

1. Coordinate placement of anchors and accessories encased in concrete with Section 033000.

B. Loop Detectors: Cut groove in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to related equipment operated by detector.

C. Pavement Marking

1. Do not apply pavement marking paint until layout, colors, and placement have been verified with Architect.

2. Sweep and clean surface to eliminate loose material and dust.

3. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer’s recommended rates to provide a minimum wet film thickness of 15 mils.

D. Wheel Stops: Install wheel stops in locations noted exposed evenly between parking stalls. Hold stop securely in place by drilling into sub-grade three pipe anchors for each stop. Anchors shall be set flush with top of stop.

3.4 CLEANING AND PROTECTING

A. After installing clean finished surfaces, touch up shop-applied finishes as required to restore damaged areas.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure parking control equipment is without damage or deterioration at the time of Substantial Completion.

3.5 DEMONSTRATION

A. Instruct Owner's maintenance personnel on proper operation and maintenance of parking control equipment. Train personnel on procedures to follow if operation fails or malfunctions.

END OF SECTION

SECTION 111900 - DETENTION EQUIPMENT

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the detention equipment as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Interview screen.
2. Detention interview shelf.
3. Detention benches.
4. Detention stool.
5. Security ceiling.
6. Detention pre-hung door and frame.
7. Detention sliding door and frame.
8. Modesty panel.
9. Fixed wall barrier.
10. Glazed barrier.
11. Gun lockers.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 SUBMITTALS

A. Product Data – Submit:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

B. Shop Drawings: Provide shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.

C. Manufacturer's recommended installation procedures.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 INTERVIEW SCREEN

A. Provide Model X-DEN-I stainless steel "Defender" interview screen, 13 ga. stainless steel reveal mount, as manufactured by Kane Innovations or approved equal.

B. Channel Frame: 3/4" x 1-9/16" x 3/4" stainless steel.

C. Wire Cloth: 10 x 10, 0.047" diameter stainless steel, alloy #304, having tensile strength of not less than 1600 pounds per lineal inch after weaving. Edge of wire cloth shall be bent 90 degrees for secure engagement into frame.

2.2 FLOOR-MOUNTED DETENTION BENCH

A. Provide "KryptoMax Floor Mount Detention Bench" Model KM-FDB-48in-HCB stainless steel bench with integrated handcuff bar as manufactured by G2 Automated Technologies, LLC, or approved equal.

B. Dimensions: 48" wide x 12" deep x 1 1/2" flanges on perimeter.

C. Bench Height: 18".

D. Seat Top: 12-gauge Type 304 #4 polished stainless steel with reinforcement plate.

E. Reinforcement Plate: 12-gauge stainless steel welded to underside of seat.

F. Pedestals: Two 2 3/8" OD diameter Schedule 40 stainless steel pedestals.

G. Base Plates: Two 7.25" x 7.25" with four 1/2" diameter holes for expansion bolts.

H. Handcuff Bar: 1.5” diameter integrated handcuff bar welded to bench front,

I. Recommended Expansion Bolts: (QTY-8) GAT-BHA-1/2 x 3 1/4-Z-SS and GAT-KM-T55 Driver.

2.3 CONTOURED DETENTION BENCH

A. Provide Model X-B29-C stainless steel bench as manufactured by Kane Innovations or approved equal.

B. Material: Contoured bench shall be formed of 12-gauge #4 polished stainless steel. End plates shall be made of 12-gauge #4 polished stainless steel. Intermediate supports shall be made of 12-gauge #4 polished stainless steel.

C. Mounting Angles: Mounting angles shall be 3" x 2" x 1/4" structural steel angles, continuous at floor and wall the length of each bench.

D. Finish: Exterior surfaces of the bench shall be #4 polished finish with welds ground smooth and blended. Mounting angles shall be thoroughly cleaned in a 5-step bonderizing process. Surfaces shall receive an electrostatically-applied thermoplastic, polyester powder coating which shall be baked to a hard mar-resistant finish in manufacturer's standard gray color.

E. Fabrication

1. Bench shall be formed to contoured shape as shown on the drawings. End plates shall be continuously welded along contour and dressed smooth. Intermediate supports shall be located at 48-inch intervals and shall be stitch welded to back side of the bench.

2. Sound deadening insulation shall be applied to the inside cavity of the bench.

F. Hardware: Each bench shall have all necessary installation hardware, including security head fastening screws.

2.4 DETENTION STOOL

A. Provide Model X-517-R stainless steel detention stool with round top as manufactured by Kane Innovations or approved equal.

B. Stool top shall be 12" in diameter with a 1-1/2" lip, formed of 14-gauge stainless steel.

C. Reinforcing channel shall be 1" x 8 3/8 x 1" x 8-3/8" long made of 7-gauge mild steel. Channel shall be welded to the underside of the top.

D. Pipe support is to be 11-gauge, 3 1/2" round tube.

E. Mounting Plate: 6" x 6" x 3/8" structural steel plate.

F. Finish: Stool top shall be satin finished. Pipe supports and mounting plate shall be in manufacturer's standard gray TGIC polyester powder.

2.5 DETENTION INTERVIEW SHELF

A. Provide Model X-SHF-Z 16 ga. stainless steel detention interview shelf as manufactured by Kane Innovations or approved equal.

2.6 SECURITY CEILING

A. Provide Model G-CLG-T galvannealed steel security ceiling as manufactured by Kane Innovations or approved equal.

B. Ceiling Components

1. Perimeter wall angles of 10-gauge steel formed 2-1/2" x 2-5/16" x 1" x 11/16"; supplied in stock lengths of 120" for field trimming, having pre-punched mounting holes.

2. Ceiling plank shall be of 14-gauge A40 galvannealed steel and formed 7/8" x 2-1/4" x 24" x 2-1/4" x 7/8" for full planks. Ceiling plank shall be perforated with 5/32" diameter holes spaced 3/8" staggered centers. Ceiling planks shall be held in place with

hold down clips along wall and No. 12 x 3/4" self-drilling screws on 20" centers where planks come together.

3. Hold down clips of 14-gauge A40 galvannealed steel formed 1-1/2" x 2-5/8". Hold down clips to be located 2 per each end of full planks and 18" on center along length of partial planks. Hold down clips shall be held in place with No.12 x 3/4" self-drilling screws, 2 per clip.

4. Sound deadening insulation of one-inch thick material of glass fiber type with 1.5lb density and below 3% moisture absorption.

   a. Insulation shall meet ASTM E 84, UL 723 and NFPA-255 fire codes (does not exceed 25 flame spread, 50 smoke developed).
   b. Airstream surface mat facing is treated with an EPA-registered anti-microbial agent to aid in the prevention of fungal and bacterial growth of mold, fungi or bacteria per ASTM C 1138, G 21, G 22.

5. Closure plate above insulation shall be of 14-gauge A40 galvannealed steel.

C. Testing and Performance

1. Acoustical Performance

   a. Ceiling system shall provide a Noise Reduction Coefficient (NRC) of not less than 0.80 when tested in accordance with ASTM C 423.
   b. Ceiling system shall provide a Sound Absorption Average (SAA) of not less than 0.78 when tested in accordance with ASTM C 423.
   c. Ceiling system shall provide a Ceiling Attenuation Class (CAC) of not less than 16 when tested in accordance with ASTM C 423.

2. Surface Burning Performance: Ceiling system is rated as Class 'A' in which Flame Spread Index does not exceed 5 with Smoke Developed Index not exceeding 35 when tested in accordance with ASTM E 84.

3. Load Performance: Load Classification of Direct Hung "Heavy" in which Load is > 19 lbs/ft with a deflection < 0.40" over a 12'-0" span when tested in accordance with ASTM C 635.

D. Finish: All exterior surfaces of the ceiling plank shall be thoroughly cleaned in a 5-step bonderizing process. The exterior surface of the ceiling plank shall receive an electrostatically applied thermoplastic, polyester powder coating (2.5 mil min. thickness) which shall be applied and baked to a hard, mar-resistant white finish.

2.7 DETENTION PRE-HUNG DOOR AND FRAME

A. Provide Model G-D12-s galvannealed steel Vantage Wall door and frame, Level 9, as manufactured by Kane Innovations or approved equal.

B. Main Frame

1. The main frame shall be built-up tubular type, measuring 1-3/4" x 2-1/2", with fixed concealment plates. Open channel frame members shall be formed of not less than 12-gauge A60 galvannealed steel sheet and shall have individual slots along the inner edges

to support the woven rod panel. The corners of the main frame shall be notched for self-aligning and robotically welded.

2. Concealment plates of 12-gauge A60 galvannealed steel shall be welded to the back of the main frame approximately 8" on center to complete the tubular shape.

3. Braces shall be built-up tubular type, measuring 8-1/2" x 2-1/2", with fixed concealment plates. Braces shall be formed of not less than 12-gauge A60 galvannealed sheet steel.

C. Rods: Woven rod panels shall be fabricated from double-crimped, low-carbon, ASTM A641 pre-galvanized steel 1/4" diameter rods, woven with 2" open space.

D. Rod Attachment: Woven rod panels shall be installed symmetrically into the slotted main frame. Slots shall be centered according to the rod pattern. Each rod shall penetrate into each slot where it contacts the main frame. Every other rod shall be welded into the slot at both ends where it penetrates the main frame.

2.8 DETENTION SLIDING DOOR AND FRAME

A. Provide Model G-D12-S galvannealed steel Vantage Wall door and frame, Level 9, as manufactured by Kane Innovations or approved equal.

B. Main Frame

1. The main frame shall be built-up tubular type, measuring 1-3/4" x 2-1/2", with fixed concealment plates. Open channel frame members shall be formed of not less than 12-gauge A60 galvannealed steel sheet and shall have individual slots along the inner edges to support the woven rod panel. The corners of the main frame shall be notched for self-aligning and robotically welded.

2. Concealment plates of 12-gauge A60 galvannealed steel shall be welded to the back of the main frame approximately 8" on center to complete the tubular shape.

3. Braces shall be built-up tubular type, measuring 8-1/2" x 2-1/2", with fixed concealment plates. Braces shall be formed of not less than 12-gauge A60 galvannealed sheet steel.

C. Rods: Woven rod panels shall be fabricated from double-crimped, lpw-carbon, ASTM A641 pre-galvanized steel 1/4" diameter rods, woven with 2" open space.

D. Rod Attachment: Woven rod panels shall be installed symmetrically into the slotted main frame. Slots shall be centered according to the rod pattern. Each rod shall penetrate into each slot where it contacts the main frame. Every other rod shall be welded into the slot at both ends where it penetrates the main frame.

2.9 MODESTY PANEL

A. Provide Model X-MOD-Z stainless steel modesty panel, Level 9, as manufactured by Kane Innovations or approved equal.

B. Material

1. Modesty panel shall be 13-gauge stainless steel with a continuous 13-gauge stainless steel edge band.

2. Mounting angles shall be made of 13-gauge stainless steel of type detailed on the drawings.

3. Tube supports shall be made of 10-gauge stainless steel with slab bracket and ceiling bracket.

4. Base plate shall be 5" x 6" 1/4" stainless steel.

5. Base plate shall be anchored to floor and ceiling with 3/8"-16 x 1" break-off head security screws.

C. Fabrication: Mounting angles shall be welded along panel and dressed smooth.

D. Hardware: All mounting fasteners are by others.

2.10 WALL BARRIER

A. Provide Model G-D12-P and Model G-D12-S galvannealed steel Vantage Wall Door and Frame, Level 9, as manufactured by Kane Innovations or approved equal.

B. Main Frame

1. The main frame shall be built-up tubular type, measuring 1-3/4" x 2-1/2", with fixed concealment plates. Open channel frame members shall be formed of not less than 12-gauge A60 galvannealed steel sheet and shall have individual slots along the inner edges to support the woven rod panel. The corners of the main frame shall be notched for self-aligning and robotically welded.

2. Concealment plates of 12-gauge A60 galvannealed steel shall be welded to the back of the main frame approximately 8" on center to complete the tubular shape.

3. Braces shall be built-up tubular type, measuring 8-1/2" x 2-1/2", with fixed concealment plates. Braces shall be formed of not less than 12-gauge A60 galvannealed sheet steel.

C. Rods

1. Model G-D12-P: Woven rod panels shall be fabricated from double-crimped, low-carbon, ASTM A641 Class A pre-galvanized, 9-gauge mild steel 0.149" diameter rods, woven 3/8" on center.

2. Model G-D12-S: Woven rod panels shall be fabricated from double-crimped, low-carbon, ASTM A641 Class A pre-galvanized, 9-gauge mild steel 3/8" diameter rods, woven with 2" open space.

D. Rod Attachment: Woven rod panels shall be installed symmetrically into the slotted main frame. Slots shall be centered according to the rod pattern. Each rod shall penetrate into each slot where it contacts the main frame. Every other rod shall be welded into the slot at both ends where it penetrates the main frame.

E. Finish: All interior and exterior surfaces of the main frame, rods and concealment plates shall be thoroughly cleaned in a 5-step bonderizing process. The surfaces shall receive an electrostatically-applied, thermoplastic, polyester powder coating (2.5 mil min. thickness) which shall be applied and baked to a hard mar-resistant finish in color as selected by the Architect.

2.11 GLAZED BARRIER

A. Provide Model S-G14-Z steel Secur-View Glazed Barrier as manufactured by Kane Innovations or approved equal.

B. Main Frame

1. The main frame shall be built-up tubular type, measuring 1-1/4" x 2-3/4", with fixed concealment plates. Open channel frame members shall be formed of not less than 14-gauge steel sheet and shall have individual slots along the inner edges to support the woven rod panel. 1/2" x 3/4" glazing pocket shall be opposite the woven rod panel. The corners of the main frame shall be notched for self-aligning and robotically welded.

2. Concealment plates of 14-gauge steel shall be welded to the back of the main frame approximately 8" on center to complete the tubular shape.

3. Braces shall be built-up tubular type, measuring 1-1/4" x 3", with fixed concealment plates. 1/2" x 3/4" glazing pocket shall be opposite the woven rod panel. Braces shall be formed of not less than 14-gauge sheet steel.

C. Perimeter Channel: Perimeter channel shall be a formed channel 1" x 1-17/32" x 1" of not less than 12-gauge sheet steel. Channel shall be provided in stock lengths with factory-punched 1/4" diameter holes approximately 12" on center for attachment to structure.

D. Rods: Woven rod panels shall be fabricated from double-crimped, low-carbon, mild steel 1/4" diameter rods, woven with 2" open space.

E. Rod Attachment: Woven rod panels shall be installed symmetrically into the slotted main frame. Slots shall be centered according to the rod pattern. Each rod shall penetrate into each slot where it contacts the main frame. Every other rod shall be welded into the slot at both ends where it penetrates the main frame.

F. Finish: All exterior surfaces of the main frame, concealment plates and rods shall be thoroughly cleaned in a 5-step bonderizing process. The surfaces shall receive an electrostatically-applied, thermoplastic, polyester powder coating (2.5 mil min. thickness) which shall be applied and baked to a hard mar-resistant finish in color as selected by the Architect.

2.12 GUN LOCKER

A. Acceptable Manufacturers: Subject to compliance with specified requirements, provide products by one of the following or approved equal:

1. Southern Folger, Inc.

2. Cornerstone

3. Bob Barker Company, Inc.

4. Sweeper Metal Fabricator Corp.

B. Type: Surface-mounted steel cabinet unit with multiple individual locking compartments designed for storage of handguns.

C. Construction: Fabricated from minimum 10-gauge (0.1345-inch) steel sheets, reinforced and welded metal cabinet construction with individual compartments felt-lined on all surfaces.

1. Compartment Size: Minimum 6" height by 8" width by 10" depth.

2. Doors: Bottom hinged swing type fabricated from same material as cabinet body; minimum 10-gauge (0.1345-inch) steel.

3. Hardware: Doors shall be equipped with manufacturer's heavy-duty cam locks and continuous hinges. Locks shall be individually keyed with master keying capabilities. Furnish with two individual keys for each compartment and two master keys for each locker location.

D. Face Plates: Provide each compartment door with small permanent face plate attached below each lock cylinder. Number face plate to match key code of each compartment lock. Numbering shall be as indicated on final reviewed shop drawings.

E. Finish: Manufacturer’s factory primed finish for field painting

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where detention equipment is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer’s recommended installation procedures.

C. Security Ceiling

1. Align wall angles in a single plane and erect ceiling planks square and true, structurally anchored.

2. Ceiling openings shall conform to the details and dimensions shown on the approved shop drawings.

3. Any abraded surface of the ceiling finish shall be cleaned and touched up with air dry paint, as approved and furnished by the ceiling manufacturer, in a color to match factory applied finish.

4. Ceiling installer shall leave the ceiling surfaces clean after installation. The General Contractor shall be responsible for final cleaning.

5. Material shall be stored in dry and protected area(s).

D. Detention Doors, Frames and Wall Barriers

1. Install in accordance with approved shop drawings and specifications.

2. Plumb and align faces in a single plane and erect barriers square and true, adequately anchored.

3. After completion of installation, barriers shall be adjusted, in working order and clean.

END OF SECTION

SECTION 113100 - APPLIANCES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the appliances as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Sinks and related plumbing fixtures - Division 22.

B. Electrical - Division 26.

1.4 SUBMITTALS

A. Submit catalog cuts, product information and technical data for each appliance.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.6 DELIVERY AND STORAGE

A. Deliver products to project site in manufacturer's undamaged protective containers.

B. Delay delivery until spaces to receive them have been fully enclosed and utility rough-ins are complete.

PART 2 PRODUCTS

2.1 APPLIANCES

A. Refer to schedule on drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where appliances are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Architect, anchoring all components firmly into position for long life under hard use.

C. Upon completion of installation and hookup to utilities, put each operating component of each appliance through at least five (5) complete operating cycles, adjusting as needed to secure optimum operation level.

D. Touch up scratches and abrasions to be completely invisible to the unaided eye from a distance of five (5) feet.

E. Promptly remove from the job site all cartons and packing material associated with the work of this Section.

END OF SECTION

SECTION 122413 - WINDOW SHADES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the window shades as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Manually-operated double roller window shades.

2. Field measurements of as-built conditions.

3. Accessories and hardware required for complete installation and operation.

1.3 QUALITY ASSURANCE

A. Provide assemblies which are complete assemblies produced by one manufacturer, including hardware, accessory items, mounting brackets, and fastenings.

B. Provide materials in colors as selected by the Architect from manufacturer's standard colors.

C. Comply with all federal mandates.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, and finishes.

B. Shop Drawings: Submit floor layout and elevations, indicating location of all window treatments, mechanism details, type and size of each unit, type and location of controls. Shop drawings must also show seaming of shade fabric. Submit shop drawings showing details of installation and relation to adjoining construction and conditions.

C. Samples: Submit full size sample of each shade type for Architect's acceptance.

D. Mock-Up

1. Install each type of shade assembly on one complete column bay for Architect's acceptance of installation details, workmanship, and operation.

2. Approved mock-up shall be used as the standard for installation of work under this Section, and no further installation work shall proceed before Architect's acceptance of the mock-up.

1.5 WARRANTY

A. Manufacturer's standard non-depreciating 25-year limited warranty covering all hardware, motors, motor control system and shade cloth.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect shades from damage, soiling and deterioration during transit, storage, and handling until Owner's acceptance.

PART 2 PRODUCTS

2.1 MANUALLY OPERATED DOUBLER ROLLER SHADES

A. Product: Provide "MECHO/5x DoubleShades" manufactured by MechoShade as basis of design

B. Shade system shall be pre-engineered overrunning clutch design that disengages to 90% during the raising and lowering of the shade. The brake can stand a pull force of 40 lb. in the stop position. Requires no adjustment. Self-lubricating hub on to which the brake system is mounted includes an articulated brake assembly which assures smooth, non-jerky operation in raising and lowering the shades. System shall include the following components:

1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.

2. Provide shade hardware that allows for removal and remounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

3. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.

4. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.

5. Provide shade hardware system that allow for operation of multiple shade bands (multi-banded shades) by a single chain operator. Connectors shall be offset to assure alignment from the first to the last shade band.

6. Provide shade hardware constructed of minimum 1/8" thick plated steel or heavier as required to support 150% of the full weight of each shade.

7. Drive Bracket/ Brake Assembly:

   a. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
   b. MechoShade Drive Bracket M5 or equal by other manufacturers noted herein.
   c. Drive Chain: #10 qualified stainless steel chain rated to 90 lb.
   d. Minimum Breaking Strength: Nickel plate chain shall not be accepted.

C. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be the same, for all shades within one room.

2. Shade Band and Shade Roller Attachment:

a. Provide extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without deflection. Provide for positive mechanical engagement with drive/ brake mechanism.
b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable/ replaceable with a snap-on/snap-off spline mounting, without having to remove shade roller from shade brackets.
c. Mounting spline shall not require use of adhesives, adhesive tapes, staples and/or rivets.

D. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be the same, for all shades within one room.

2. Shade Band and Shade Roller Attachment:

a. Provide extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without deflection. Provide for positive mechanical engagement with drive/ brake mechanism.
b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable/ replaceable with a snap-on/snap-off spline mounting, without having to remove shade roller from shade brackets.
c. Mounting spline shall not require use of adhesives, adhesive tapes, staples and/or rivets.

E. Side Channels: Provide standard "blackout" side channels where black-out shades are required. Channels shall be extruded aluminum, with a black anodized finish, color selected by the Architect.

2.2 SHADE CLOTH

A. Shade cloth shall be "Eco-Veil" group, 1350 Series of weave, color and 50% optical properties as selected by the Architect made by MechoShade, or Ambient Screen (PVC Free) by Rollease Acmeda Contract or equal by other manufacturers noted herein.

B. Where black-out shades are indicated, shade cloth shall be "Equinox 0100 Series" opaque acrylic black-out shade cloth made by MechoShade, or Rollease Acmeda Contract Shade Cloth Sierra Sol Mesa, or equal by other manufacturers noted herein; color selected by the Architect.

2.3 FABRICATION

A. The shade and the fabric shall hang flat without buckling or distortion. The edge, when trimmed, shall hang straight without curling or raveling. An unguided roller shade cloth shall roll true and straight, without tracking sideways more than +/- 1/8" in either direction due to warp distortion or weave design. Shades shall fill window openings from head to sill and jamb to jamb.

3.2 INSPECTION

A. Examine the areas and conditions where window treatments are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.3 INSTALLATION, GENERAL

A. Coordinate with the work of other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the indicated design and the installation recommendations of the manufacturer as approved by the Architect.

C. Upon completion of the installation, put all components through at least ten (10) complete cycles of operation, adjusting as necessary to achieve optimum operation.

3.4 INSTALLATION OF MANUAL ROLLER SHADES

A. Install roller shades level, plumb, square, and true according to manufacturer’s written instructions and located so shade band is not closer than 2" to interior face of glass. Allow proper clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

3.5 PROTECTION AND CLEANING

A. Protect installed units to ensure proper operating condition, without damage or blemishes. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 124813 - FLOOR MATS AND FRAMES

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the floor mats and frames as shown on the drawings and specified herein including, but not limited to, the following:

1. Stainless steel floor grate.

1.3 RELATED SECTIONS

A. Concrete recess - Section 033000.

1.4 QUALITY ASSURANCE

A. Manufacturer: Except as otherwise indicated, provide entrance mats and accessories by a single manufacturer for entire project.

1.5 SUBMITTALS

A. Product Data: Submit manufacture's specifications and installation instructions or entrance mat. Include methods of installation for each type of substrate.

B. Samples: Submit samples for each type and color of exposed entrance mat, frames and accessories required. Provide 12" square samples of mat including frame.

C. Maintenance Data: Submit manufacturer's printed instructions for cleaning, drying, maintaining, and rehandling of removable entrance mat units.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 STAINLESS STEEL FLOOR GRATE

A. Furnish and install KD58, 5/8" stainless steel floor grate manufactured by Kadee Industries, or approved equal by C/S Group.

B. Tread Material: Type 304 stainless steel 0.071" x 0.177" surface wire, No. 4 satin finish.

1. Wire Spacing: Standard slot openings of 0.125".

C. Support Rods: Type 304 Stainless steel 0.070" x 0.5", spaced 1" on center.

D. Framing: Type 304 stainless steel.

E. Accessories: Provide hidden locking devices to prevent warping and rattling. Furnish number of lock downs as recommended by manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Provide entrance floor mats capable of withstanding a uniform floor load of 1,500 lbf/sq. ft.

B. Provide entrance floor mats with a minimum Coefficient of Friction of 0.6 as measured by the James Machine defined in ASTM D 2047 using Standard Neolite in dry and wet testing.

C. Provide entrance floor mats capable of withstanding a rolling load of 1,000 lbs. per wheel for 1,000 passes with no visible damage or permanent deflection.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where floor mats and frames are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install mat frames integrally with principal pour of concrete floor system. Locate, align, and level frame members accurately.

B. Protection: Upon completion of frame installations and concrete work, provide temporary filler of plywood or fiberboard in mat recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project reaches substantial completion.

C. Delay installation of mats until work on the project reaches substantial completion.

D. Install grating mat in frame and anchor with hidden lock downs.

END OF SECTION

SECTION 142100 - TRACTION ELEVATORS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the traction elevators as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. One (1) gearless, machine-roomless electric traction elevator.

1.3 RELATED SECTIONS

A. Miscellaneous Metals - Section 055000, for elevator pit ladders.

B. HVAC - Division 23, for ventilation for hoistways.

C. Electrical - Division 26.

1.4 QUALITY ASSURANCE

A. Elevator Code: Except for more stringent requirements as indicated or imposed by governing regulations (which must be complied with), comply with applicable requirements of the "American Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks," (ANSI A17.1), published by The American Society of Mechanical Engineers, hereinafter referred to as the "Code." Comply with prevailing handicapped code requirements.

B. Electrical Code: For electrical work included in the elevator work, comply with the "National Electrical Code" (ANSI C1) by NFPA.

C. Elevator Manufacturer: Elevator manufacturer shall make all major apparatus such as machines, motor-generators, controllers, power units, cylinders, etc. Elevators shall be equal to "EcoSpace" as manufactured by Kone, or equal made by Otis Elevator Company, Schindler Elevator Corp., or approved equal.

D. Tolerance for Elevator Travel: Plumb and secure guide rails within an overall tolerance of 1/4" (measured with no wind or solar load on building) and within 0.01" joint offset on rail surface. Limit short-span tolerance (measured between upper and lower car guides, continuously) to the following:

1. Plumb Tolerance: 1/8".

E. Tolerance for Car Leveling: Position stopping car within following tolerance, up or down, regardless of load and direction of travel:

1. Car Floor to Landing: 1/4" out of level.

F. Fire Resistance: Except as otherwise indicated, comply with NFPA Standard No. 80 for construction and installation of hoistway entrance. Provide each door unit bearing UL label of approval ("B" label, except as otherwise indicated) as a "Fire Door" if horizontal sliding or vertical bi-parting, and as a "Frame and Fire Door Assembly" if swinging. Where required by NFPA Standard No. 80, provide separate UL labels of approval on hardware, sills, closers and other accessory items of hoistway entrance.

G. Laboratory Testing: Comply with Code for laboratory testing of elevator component parts, including buffers, interlocks, door contacts, wire rope, connectors, fasteners, and other materials and products used in the elevator work. Label such products and materials to indicate the testing and certification by the laboratory.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit the manufacturer's specifications and installation instructions for the complete elevator system, and for each component or product used in the system. Include certified laboratory test reports on components as specified or required by Code. Include a complete listing and description of performance and operating characteristics. Include maximum and average power demands and requirements for temporary power. Include complete description of operation systems, documenting fulfillment of the requirements.

B. Shop Drawings: Submit shop drawings for the elevator system and its components, including typical details of assembly, erection and anchorage drawn at large scale. Show maximum dynamic and static loads imposed on the building structure at points of support for the elevator work. Submit smaller scale drawings of the overall plans, elevations and sections to show the floors served, travel distances and similar considerations of the work. Include wiring diagrams for the entire system of power distribution, lighting, controls, signals, communication, cab finishes, etc. Assemble shop drawings into one coordinated submittal.

C. Maintenance Manuals: Submit 3 copies of bound maintenance and operating instructions, parts lists, recommended spare parts and emergency parts inventory, sources of purchase and similar information. Content of manual must be acceptable to firm selected by Owner to perform continuing maintenance.

1. Provide diagnostic unit to Owner with Operating and Maintenance Manuals at completion of project.

2. In addition, provide 3 electronic copies of manual.

1.6 PERMITS AND INSPECTIONS

A. Obtain and pay for all necessary municipal and State inspections and permits and make such tests as are required by the regulations of such authorities. These tests shall be made in the presence of the authorized representatives of such authorities.

1.7 TESTS

A. When installation is fully completed, the elevator manufacturer shall demonstrate to the entire satisfaction of the Architect and the Owner the proper operation of every part of the equipment and compliances thereof with contract requirements and with all applicable requirements of the ANSI Code. The inspection procedure outlined in the American Standard Practice for the Inspection of Elevators, Inspectors, Manual A17.2, shall form a part of the final inspection.

1.8 MAINTENANCE

A. The elevator manufacturer shall furnish maintenance on each piece of elevator equipment for a period of twelve (12) months after its acceptance. This maintenance shall include examination, adjustment and lubrication of all elevator equipment. The elevator manufacturer shall also repair or replace electrical and mechanical parts produced by the manufacturer of the equipment concerned.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard two year period or other period maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Provide Model "Kone EcoSpace" gearless machine roomless service elevator with the following characteristics specified herein.

2.2 ELEVATOR CHARACTERISTICS

A. Equipment Control: KCM831.

B. Quantity of Elevators: 1.

C. Landings: 3.

D. Openings: 3 Front Openings.

E. Travel: As indicated

F. Rated Capacity: 2500 lbs.

G. Rated Speed: 150 fpm.

H. CarDimensions: 6'-8" wide x 4'-3" front to back.

I. Hoistway Dimensions: 8’-8” wide x 5’-9” front to back.

J. Entrances: 3’-6” wide x 7'-0” high; single speed side opening door; stainless steel finish.

K. Main Power Supply: 208 Volts, 3-phase, 60 hertz.

L. Operation: Simplex.

M. Machine Location: Inside the hoistway mounted on car guide rail.

N. Control Space Location: Integral closet at top landing.

O. Fixtures: KONE KSS 140 Series; #4 stainless steel finish; ADA telephone; Riding car direction lanterns.

P. Car Enclosure: KONE 8'-0" high cab; stainless steel car door; stainless steel walls with handrails on side and rear walls; KONE LF-1 ceiling; pads and hooks.

Q. Pit Depth: 5'-0".

R. Overhead: 13'-0" clear to underside of hoist beam.

S. Elevator equipment shall conform to the requirements of Seismic Zone 2.

T. Maintenance Service Period: 12 Months.

U. Operating Features:

1. Anti-nuisance.

2. Fan and light protection.

3. Load weighing bypass.

4. Top of car inspection.

5. Car to lobby operation.

6. Generator back-up.

7. Keyed operation.

8. Automatic recovery system, single car battery powered lowering in case of generator power loss.

a. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

V. Door Control Features:

1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.

2. 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.

3. 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 in diameter when inserted between the car doors at vertical positions from within 1 inch above the sill to 71 inches 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" 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.

4. 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.

5. 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" above the sill to ~55" above the sill (mid-thigh to shoulder of a typical adult).

6. The secondary protection shall have an anti-nuisance feature that 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.

7. 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.

8. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

2.3 EQUIPMENT: CONTROL ROOM COMPONENTS

A. Controller: A microcomputer-based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.

1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.

2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.

3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC) and low voltage (< 30 volts DC).

4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for Lifts, Escalators, and Passenger Conveyors, Part 2 – Immunity."

B. Drive: Regenerative drive system shall be provided.

2.4 EQUIPMENT: MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

B. Governor: The governor shall be a tension type governor.

C. Buffers, Car and Counterweight: Polyurethane buffers shall be used.

D. Hoistway Operating Devices

1. Emergency stop switch in the pit.

2. Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Coated Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords.

H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.

I. Fascia: Galvanized sheet steel shall be provided at the front and rear of the hoistway.

J. Hoistway Entrances

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 of UL fire rated steel.

2. Sills shall be extruded aluminum.

3. Doors: Entrance doors shall be of stainless steel construction with vertical internal channel reinforcements.

4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.

5. Entrance Finish: Stainless Steel.

6. Entrance Marking Plates: Entrance jambs shall be marked with 4" x 4" plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.

7. Sight Guards: Black sight guards will be furnished with any metal finish door. Powder-coated matching sight guards will be furnished with powder-coated doors.

2.5 EQUIPMENT: CAR COMPONENTS

A. Car Frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.

B. Finish Materials: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated:

1. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8" nominal thickness.

2. Floor Finish: As scheduled.

3. Satin Stainless Steel: ASTM A 240/A, Type 304, with No. 4, directional satin finish.

   a. Surface is satin polished after rolling.

4. Stainless Steel Bars: ASTM A 276, Type 304, No. 4 finish.

5. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet conforming to ASTM A 240.

6. Fabricate car with recesses and cutouts for signal equipment.

7. Fabricate car door frame integrally with front wall of car.

8. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from 16 ga. stainless steel.

9. Sills: Extruded aluminum, with grooved surface, 1/4" thick.

10. Ceiling: Polygal Translucent three panel suspended ceiling with T-5 Fluorescent lighting and brushed aluminum frame.

11. Handrails: Round tube brushed aluminum, 1-12". Rails are to be located on back wall and side walls of car enclosure.

12. Provide stainless steel blanket hooks and two (2) complete sets of full height, quilted fire-retardant protective pads.

C. 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 alarm bell in the event of building emergency generator power failure.

D. 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 dB(A) at a distance of 3.0m from the device. Siren shall respond with a delay of not more than 1 second after the switch or push button has been pressed.

E. Fan: A two-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. This two-speed fan produces airflow rates of 5.8 and 7.4 m^3/min on low and high setting respectively. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

F. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

G. Roller Guides: Rubber roller guides shall be mounted on the top and the bottom of the car and counterweight. Car roller guides shall be 3". The counterweight roller guides shall be 3" at the top and the bottom.

H. Certificate Frame: Provide a Certificate frame with a satin stainless steel finish.

2.6 FIXTURES

A. Car and Corridor Pushbuttons: Provide 1" diameter discs as pushbuttons. They shall protrude 1/8" to 1/4" beyond the faceplate and will have a maximum of 1/8" throw for activation. Stainless steel by Architect.

B. Car Position Indicator

1. Provide a 1-1/2" high liquid crystal or LED type position indicator for the car to indicate to the passengers the location of the car in the hoistway. Changes from one designation to another shall be instantaneous and shall be accomplished approximately midway between floors. The position indicators shall be flush mounted in the main car station without a faceplate.

2. The fixture shall be KSS-500 designs by Kane.

C. Corridor Pushbutton Stations

1. Provide up and down buttons at intermediate landings and single button at terminal landings. The buttons shall have call registered lights that shall extinguish as the calls are answered.

2. Provide a fire department key switch in the Main Lobby corridor pushbutton station.

3. All station internal parts shall be mounted to the box, not attached to the cover plate.

4. Provide 304 stainless steel with No. 4 finish cover plates for all pushbutton stations.

5. All hall and cab buttons shall be tamperproof.

D. Direction Arrows

1. Provide a fixture containing direction arrows and audible gong at the side of the swing front return panel (car door jamb) without a faceplate.

2. Direction arrows shall indicate the direction of car travel when the doors are 3/4 open, KSS-500.

E. Work Lights and Receptacles

1. A single 110 volt specification grade lighting receptacle shall be installed in the car in the service cabinet.

2. Provide work lights and receptacles at top and bottom of elevator car. Provide lights with wire guards and local switch.

F. Electronic Door Control

1. An electronic door control unit shall be provided as required in connection with automatic elevator operation and power operated elevator doors. This unit shall consist of a photoelectric and light source device located on the hoistway side of the car doors. Two (2) paralleled light rays shall project across the elevator entrance.

2. The interruption of the light rays shall readjust the normal present door open time causing:

    a. The doors to remain open as long as the rays are interrupted.
    b. The closing of the doors a short interval after light rays are re-established the reversal and reopening of doors if the light rays are interrupted while the doors are closing.

3. The time interval for door closing after the re-establishment of the light rays shall be adjustable. This unit shall also distinguish between car and corridor calls and adjust the door open time accordingly.

4. If, for any reason, the doors are held open for an extended time (approximately 15 seconds) by a passenger continually standing in the entrance holding the door open, the door shall begin to close at a reduced speed with a gentle nudging force. During the nudging operation a distinctive buzzer will sound. Nudging will be effective until the doors are fully closed.

5. A switch shall be provided in the car operation panel which shall permit disconnecting this electronic unit, when desired.

G. Reopening Device: All elevators with electric power operated doors and using an automatic method of elevator operation shall have an automatic reopening device on the car door so arranged that, in the event the door either approaches or meets an obstruction in closing, the car doors and the hoistway door shall automatically stop and reopen. The device shall be so designed and adjusted as to minimize the possibility of injury to passengers. The device shall not project into hoistway door opening when the doors are in the fully open position.

H. Emergency Lighting Fixture: Provide a self-powered emergency light unit in the elevator car consisting of a light fixture and a power pack unit.

PART 3 EXECUTION

3.1 INSPECTION

A. Study the Contract Documents with regard to the work as shown and required so as to insure its completeness.

B. Examine surface and conditions to which this work is to be attached or applied, and notify the Architect in writing, if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.

C. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions which are at variance with those on the accepted shop drawings to the attention of the Architect. Obtain the decision regarding corrective measures before the start of fabrication of items affected.

D. Cooperate in the coordination and scheduling of the work of this Section with the work of other sections so as not to delay job progress.

3.2 INSTALLATION

A. Install the elevator with skilled workmen in strict accordance with the accepted shop drawings and other submittals.

B. Comply with the code, manufacturer's instructions and recommendations.

C. Coordinate work with the work of other trades for proper time and sequence to avoid construction delays and to insure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.

D. Accurately and rigidly secure supporting elements within the shaftways to the encountered construction, within the tolerances established.

E. Provide and install motors, switches, controls, safety and maintenance, operating devices in strict accordance with the submitted wiring diagrams and applicable codes and regulations having jurisdiction.

F. After installation touch up in the field surfaces of shop primed elements which have become scratched or damaged.

G. Lubricate operating parts of system as recommended by the manufacturer.

3.3 PROTECTION AND CLEANING

A. During shipment and installation, adequately protect surfaces against accumulation of paint, mortar, mastic and disfiguration or discoloration, and damage.

B. Upon completion, remove protection and thoroughly clean work and have it free from discoloration, scratches, dents and other surface defects.

C. The finished installation shall be free of defects. Before final completion and acceptance of the building, repair and/or replace defective work, to the satisfaction of the Architect and the Owner at no additional cost.

END OF SECTION

SECTION 210517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

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. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 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).

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.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Smooth-On.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. 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 1/4-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.

C. 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 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing 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.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves.

2. Interior Partitions:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves.

END OF SECTION 210517

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 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel 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 and Existing Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece cast brass or split-plate steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome finish.
d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
f. Insulated Piping: One-piece stamped steel or split-plate, with polished, chrome-plated finish.
g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, with polished, chrome-plated finish.
k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated] [polished brass] finish.
l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with [polished, chrome-plated finish.
n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.

t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

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.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES 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. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Check valves.
4. NRS gate valves.
5. Indicator posts.
6. 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:

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 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. 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.
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 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. 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.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze with EPDM coating
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 CHECK VALVES

A. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
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.

2.5 BRONZE OS&Y GATE VALVES

A. 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.
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.
10.

2.6 NRS GATE VALVES

A. 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.
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.

2.7 TRIM AND DRAIN VALVES

A. Ball Valves:

1.
2. Description:

a. Pressure Rating: 175 psig
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 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

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 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

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 210523

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPRESSION 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. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. 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. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to.

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.

C. NFPA Compliance: Comply with NFPA 13

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Copper Pipe and Tube Hangers:

1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped 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.
7. Metallic Coating: Hot-dip galvanized
8. Paint Coating: Green epoxy.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material: Water-repellent-treated, ASTM C533, Type I calcium silicate with 125-psi minimum compressive strength.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved 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: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1.
2. Indoor Applications: Zinc-coated or Stainless steel.
3. Outdoor Applications: Stainless steel.

2.7 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, 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 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. 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.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. 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. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. 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.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

M. 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 of same thickness as piping insulation.

3.3 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.

3.4 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.

3.5 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.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements 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 finishes.

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 thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. 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. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. 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.
8. 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.
9. 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.

J. 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.

K. Hanger-Rod Attachments: Comply with NFPA requirements.

L. Building Attachments: Comply with NFPA requirements. 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. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Comply with NFPA requirements. 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.

N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Vibration isolators.
   2. Seismic-restrain devices.
   3. Restraining braces.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Retain a professional engineer licensed in the State of New York to provide seismic calculations.

B. Seismic-Restraint Loading:

1.	Seismic Importance Factor:	1.50
2.	Occupancy/Construction Type:	B/IIB
3.	Spectral Response Accel. (SS):	0.247g
4.	Spectral Response Accel. (S1):	0.056g
5.	Spectral Response Coeff. (SDS):	0.263g
6.	Spectral Response Coeff. (SD1):	0.089g
7.	Response Modification Factor (R):	5.0
8.	Overstrength Factor	2.5
9.	Seismic Design Category:	C
10.	Site Class:	D
11.	Seismic Response Coefficient (CS):	0.1976
12.	Basic Seismic Force Resisting System:	Special Reinforced Masonry Shearwall
13.	Analysis Procedure:	Equivalent Lateral Force
14.	Design Base Shear:	663 KIPS

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and testing agency.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval

by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.
10. Or Engineer Approved Equal.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant **rubber**.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

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. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or 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.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless

steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 21 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

END OF SECTION 210548

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION 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. Warning signs and labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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]:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. LEM Products Inc.
8. Marking Sevices Inc.
9. National Marker Company.

10. Seton Identification Products.
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. 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.

H. Fasteners: Stainless-steel rivets.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.
11. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. 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: Size letters according to ASME A13.1 for piping.

F. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.3 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brimar Industries, Inc.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. Marking Sevices Inc.

2. Lettering Size: Size letters according to ASME A13.1 for piping.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel, or acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: White, exterior, alkyd enamel, or acrylic enamel. Paint may be in pressurized spray-can form.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.
11. Seton Identification Products.

B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Sevices Inc.
10. Seton Identification Products.

B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Pipe-Label Locations: 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. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a 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.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 2 inches square.
b. Wet-Pipe Sprinkler System: 2 inches square.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

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. Exposed-type fire-department connections.

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 fire-department connection.

PART 2 - PRODUCTS

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

A. Standard: UL 405.

B. Type: Exposed, projecting, for wall mounting.

C. Pressure Rating: 175 psig minimum.

D. Body Material: Corrosion-resistant metal.

E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

F. Caps: Brass, lugged type, with gasket and chain.

G. Escutcheon Plate: Round, brass, wall type.

H. Outlet: Back, with pipe threads.

I. Number of Inlets: Two.

J. Escutcheon Plate Marking: Similar to "AUTO SPKR."

K. Finish: Polished chrome plated.

L. Outlet Size: NPS 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."

B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Hose stations.
5. Monitors.
6. Fire-department connections.
7. Alarm devices.
8. Manual control stations.
9. Control panels.
10. Pressure gauges.

1.2 DEFINITIONS

A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.3 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.4 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is as follows:
   a. NPS 2-1/2 Hose Connections: 100 psig.

2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
   a. NPS 2-1/2 Hose Connections: 175 psig.

C. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fire-suppression standpipes, 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. HVAC duct work.
3. Lighting fixtures.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Fire-hydrant flow test report.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes 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 ASME Boiler and Pressure Vessel Code.

C. 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. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, 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 30, Galvanized-Steel and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Standard-Weight, Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.

D. Galvanized, Steel Couplings: ASTM A 865, threaded.

E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME B16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

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]:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.
d. Shurjoint Piping Products.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Galvanized, 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.
4. 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.

2.3 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].

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

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:

a. Anvil International, Inc.
b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:

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:

    a. Anvil International, Inc.
    b. Fivalco Inc.
    c. Global Safety Products, Inc.
    d. Kennedy Valve; a division of McWane, Inc.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Pratt, Henry Company.
    h. Shurjoint Piping Products.
    i. Tyco Fire & Building Products LP.
    j. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

D. Check Valves:

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:

    a. AFAC Inc.
    b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    c. Anvil International, Inc.
    d. Clow Valve Company; a division of McWane, Inc.
    e. Crane Co.; Crane Valve Group; Crane Valves.
    f. Crane Co.; Crane Valve Group; Jenkins Valves.
    g. Crane Co.; Crane Valve Group; Stockham Division.
    h. Fire-End & Croker Corporation.
    i. Fire Protection Products, Inc.
    j. Fivalco Inc.
    k. Globe Fire Sprinkler Corporation.
    l. Groeniger & Company.
    m. Kennedy Valve; a division of McWane, Inc.
    n. Matco-Norca.
    o. Metraflex, Inc.
    p. Milwaukee Valve Company.
    q. Mueller Co.; Water Products Division.
    r. NIBCO INC.
    s. Potter Roemer.
    t. Reliable Automatic Sprinkler Co., Inc.
    u. Shurjoint Piping Products.
    v. Tyco Fire & Building Products LP.
    w. United Brass Works, Inc.
    x. Venus Fire Protection Ltd.
    y. Victaulic Company.

z. Viking Corporation.
aa. Watts Water Technologies, Inc.

2. Standard: UL 312.
3. Pressure Rating: 175 psig.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Iron OS&Y Gate Valves:

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:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. Indicating-Type Butterfly Valves:

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:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Shurjoint Piping Products.
h. Tyco Fire & Building Products LP.
i. Victaulic Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

    a. Valve Type: Ball or butterfly.
    b. Body Material: Bronze.
    c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

    a. Valve Type: Butterfly.
    b. Body Material: Cast or ductile iron.
    c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

G. NRS Gate Valves:

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:

    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. American Valve, Inc.
    c. Clow Valve Company; a division of McWane, Inc.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Kennedy Valve; a division of McWane, Inc.
    f. Mueller Co.; Water Products Division.
    g. NIBCO INC.
    h. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

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:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

C. Ball Valves:

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:

a. Affiliated Distributors.
b. Anvil International, Inc.
c. Barnett.
d. Conbraco Industries, Inc.; Apollo Valves.
e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:

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:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

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:

   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. 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.

C. Automatic (Ball Drip) Drain Valves:

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:

   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building 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.

2.7 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

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:

   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.

c. Fire-End & Croker Corporation.
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation.
f. Guardian Fire Equipment, Inc.
g. Kennedy Valve; a division of McWane, Inc.
h. Mueller Co.; Water Products Division.
i. NIBCO INC.
j. Potter Roemer.
k. Tyco Fire & Building Products LP.
l. Wilson & Cousins Inc.

2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 2-1/2, as indicated).
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Rough brass or bronze.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

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] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. GMR International Equipment Corporation.
d. Guardian Fire Equipment, Inc.
e. Potter Roemer.
f. <Insert manufacturer's name>.

3. Standard: UL 405.
4. Type: Flush, for wall mounting.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Rectangular, brass, wall type.
10. Outlet: With pipe threads.
11. Body Style: Horizontal.
12. Number of Inlets: Three.

13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE"
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 6.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

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]:

   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
   e. <Insert manufacturer's name>.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-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, 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:

   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

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:

   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.

c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Viking Corporation.
f. Watts Industries (Canada) Inc.

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.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

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:

a. AFAC Inc.
b. Barksdale, Inc.
c. Detroit Switch, Inc.
d. Potter Electric Signal Company.
e. System Sensor; a Honeywell company.
f. Tyco Fire & Building Products LP.
g. United Electric Controls Co.
h. 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, 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:

a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Kennedy Valve; a division of McWane, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.

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.

2.10 PRESSURE GAGES

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:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft Inc.
3. Brecco Corporation.
4. 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.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."

B. 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, as far as practical.

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.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main 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 will not be subject to freezing.

J. Fill wet-type standpipe system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "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 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 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. 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.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 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.

3.7 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

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 standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends joints.

B. Standard-pressure, wet-type, fire-suppression standpipe piping,[NPS 5 to NPS 8, 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, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

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.

B. Related Requirements:

1. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

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.

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. HVAC piping and ductwork.
3. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.

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."

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 Owners no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's, Construction Manager's, and Owner'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-psi minimum working pressure.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, 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. Thinwall Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller.

D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

E. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

F. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

G. Malleable- or Ductile-Iron Unions: UL 860.

H. Cast-Iron Flanges: ASME 16.1, Class 125.

I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.

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.

J. 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.

K. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Apollo-Shurjoint Piping Products USA Inc.
c. Corcoran Piping System Co.
d. National Fittings, Inc.
e. Smith-Cooper International.
f. Tyco Fire Products LP.
g. Victaulic Company.

2. Pressure Rating: 175-psig.
3. Galvanized, and 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.

L. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. 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.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-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, provide products by one of 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. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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, provide products by one of the following:

    a. AGF Manufacturing, Inc.
    b. Anvil International.
    c. Apollo-Shurjoint Piping Products USA Inc.
    d. National Fittings, Inc.
    e. Tyco Fire Products LP.
    f. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175-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, provide products by one of 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: 175-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. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fivalco Inc.
b. FlexHead Industries, Inc.
c. Gateway Tubing, Inc.
d. Victaulic Company.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.6 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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 Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Bronze.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ADT Security Services, Inc.
   b. McDonnell & Miller.
   c. Potter Electric Signal Company, LLC.
   d. System Sensor.
   e. Viking Corporation.
   f. WATTS.

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.
7. Design Installation: Horizontal or vertical.

B. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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 minimum.

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 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. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install alarm devices in piping systems.

I. 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 ¼ 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.

J. Fill sprinkler system piping with water.

K. 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."

L. 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."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 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 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 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. 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.

O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

P. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. 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.

Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 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."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

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.

3.8 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.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. 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.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, Schedule 40 black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Standard-weight, Schedule 40 black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Thinwall, Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Thinwall, Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
4. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Concealed Sidewall sprinklers.

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. 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 211313

SECTION 21 13 21 - FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

The Contractor shall procure and furnish all labor, materials, tools and equipment required for the installation of fire suppression systems for the gasoline fueling systems, as indicated on the Contract Drawings or as directed by the Construction Manager.

1.2 RELATED WORK:

SECTION 23 13 13:	FACILITY UNDERGROUND FUEL STORAGE TANKS
SECTION 40 22 00:	PETROLEUM PRODUCTS PIPING
SECTION 40 70 00:	INSTRUMENTATION FOR PROCESS SYSTEMS

1.3 APPLICABLE REFERENCES:

The following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation and shall be the latest published versions.

A. National Fire Protection Association

NFPA 17 Standard for Dry Chemical Extinguishing Systems

NFPA 30 Flammable and Combustible Liquids Code

B. Underwriter's Laboratory

U.L. 1254 Standard for Pre-Engineered Dry Chemical Extinguishing System Units

1.4 SUBMITTALS:

A. The Contractor shall submit manufacturer's specifications, catalog cuts indicating material type, etc., installation instructions, and test results.

B. The Contractor shall submit manufacturer's certification that product is compatible with E85 gasoline.

C. Working Drawings:

1. Working drawings shall be submitted to the Construction Manager for approval before the work commences. The working drawings shall clearly indicate the locations and relationship of all equipment, piping, supports, and appurtenances. The drawings shall be fully dimensioned to determine the suitability of the installation.

2. The working drawings shall include a complete and comprehensive bill of materials keyed to the drawings. The bill of materials shall provide all information to determine compliance with the Contract Drawings and Specifications.

3. The Contractor is responsible for verifying all dimensions in the field and for insuring that interferences do not exist between the Contractor's work and the surroundings.

4. Any deviations from the Contract Drawings because of physical interferences, substitutions, of filed verification shall be clearly indicated on the working drawings.

1.5 ALTERATIONS TO ACCOMMODATE EQUIPMENT:

The Contract Drawings indicate a typical installation based on a certain make or brand of equipment, and are not to be construed as representing the layout for any other make or brand. Any alterations which are necessary to adequately and satisfactorily accommodate the equipment to be installed under this Contract shall be made by the Contractor at his own expense, in accordance with the Contract and Specifications and subject to approval by the Construction Manager.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The fire extinguishing system shall be the stored pressure dry chemical pre-engineered fixed nozzle type as manufactured by Johnson Controls, or an approved equal. The system shall provide for protection of the gasoline vehicle fueling areas described and defined in the Contract Drawings.

B. The system shall be capable of automatic and manual actuation. It shall be tested in accordance with UL 1254 and be listed by Underwriters Laboratories. The system shall be installed and maintained in accordance with NFPA 17, NFPA 30, the manufacturer's UL Listed Technical Manual, and all local and/or State Codes and Standards.

C. The system shall be designed for operation at ambient temperatures from -40° F to 120° F (-40° C to 49° C).

D. The system shall be designed for operation in a minimum 10 mile per hour wind.

2.2 CYLINDER AND AGENT

A. Agent. The extinguishing agent shall be Pyro-Chem monoammonium phosphate-based dry chemical agent (ABC type) or an approved equal.

B. Cylinders. Steel cylinders manufactured, tested, and marked in accordance with DOT 4BW350 shall be used to store the extinguishing agent. Pyro-Chem Cylinder Model ATD-75 or an approved equal shall be used with extinguishing agent fill weight of 75 lbs. All cylinders shall be charged with dry nitrogen to 350 psig at 70° F.

C. Cylinder valve. A pressure sealed poppet-type valve having a brass body, stainless steel stem with rubber seat washer, fusible safety relief assembly, and pressure gauge shall be used on all agent cylinders.

D. Cylinder bracketing. Cylinders shall be mounted vertically. The cylinders shall be secured by use of a steel mounting bracket affixed to a rigid bracket capable of supporting the weight of the filled cylinder and the concussion of cylinder discharge.

2.3 ACTUATION CONTROLS

A. Control Head. The system control head shall include a Model ECH-Series Control Head as manufactured by Johnson Controls, or an approved equal. The control head shall be mounted directly on the valve of a pneumatic actuating cylinder. A carbon dioxide pilot cartridge that complies with MIL-C0601G shall be used as an integral component of the control head. Control head status shall be visually indicated by a SET/FIRED indicator.

B. Detection. The ambient temperature of the hazard area shall be monitored by fixed temperature electrical thermal detectors. When the temperature of the hazard area exceeds the rating of any detector, the detector shall close a normally open switch element within the

detector, sending a signal to the control head. This signal shall energize a solenoid in the control head which exercises the control head and actuates the system.

C. Pneumatic actuation. The system shall have a PAC-Series Pneumatic Actuating Cylinder as manufactured by Johnson Controls, or an approved equal. The PAC cylinder shall have a valve that opens upon activation of the control head. The valve shall release nitrogen from the PAC cylinder into the pneumatic pipe and tubing network. This nitrogen shall depress a piston above the valve stem in each agent cylinder, opening each agent cylinder valve and releasing the pressurized agent.

D. Manual actuation. The system shall have mechanical manual actuation capability requiring no electrical power. This is accomplished locally by twisting the handle on the cover of the ECH-Series Control Head, or remotely by means of a Model RPS-M remote mechanical pull station as manufactured by Johnson Controls, or an approved equal.

E. Auxiliary output. The system shall shut off power to all fuel dispensing units in the event of system actuation. This is accomplished by means of dry contacts on a Model MS-DPDT micro switch as manufactured by Johnson Controls, or an approved equal, installed in the ECH-Series Control Head. The micro switch may also be used for auxiliary functions such as audible alarms or alarm signaling.

F. Supervision. A Model SM Series Solenoid Monitor as manufactured by Johnson Controls, or an approved equal, shall be used to supervise the integrity of all electrical actuation circuits, whether automatic or manual.

G. Manual electrical actuation (optional). The system can have electrical manual actuation capability. This is accomplished by the use of a Model RPS-E2 Remote Electrical Pull Station as manufactured by Johnson Controls, or an approved equal, installed in the automatic detection circuit.

2.4 DISTRIBUTION NOZZLES

A. Nozzles. The system shall utilize Model N-ATD Discharge Nozzles as manufactured by Johnson Controls, or an approved equal, to distribute agent throughout the hazard area. The quantity, location, and orientation of nozzles shall be in accordance with Pyro-Chem, "The Attendant Gasoline Station Fire Suppression System Technical Manual", Part No. 550670, latest revision.

B. Nozzle covers. All nozzles shall be installed with nozzle covers to prevent foreign matter from clogging the discharge nozzles.

2.5 PIPE AND FITTINGS

A. Pipe. All pipe shall be Schedule 40 black, galvanized, chrome plated or stainless steel pipe in compliance with NFPA 17. All pipe ends shall be thoroughly reamed after cutting, and all oil, chips, and debris shall be removed prior to nozzle installation.

B. Fittings. Standard weight malleable, galvanized, chrome plated or stainless steel fittings shall be used.

C. Size. All system pipe and fittings will be sized in accordance with the system Technical Manual. No substitutions are allowed.

D. Joints. No joint sealant shall be used in the discharge piping. Exception: Teflon tape may be used to ensure a snug fit.

E. Straps. All system discharge pipe shall be securely fastened by means of pipe hangers and/or pipe straps. UL listed pipe hangers shall be used.

F. Union. A union shall be installed in the discharge piping conveniently close to the cylinder valve to permit disconnection for inspection and service.

PART 3 - EXECUTION

3.1 INSTALLATION:

All equipment shall be installed in accordance with the Manufacturer's instructions.

END OF SECTION 21 13 21

NO TEXT ON THIS PAGE

SECTION 212200 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Control and alarm panels.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

1.2 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPO: Emergency Power Off.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include design calculations.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.

1. Indicate compliance with performance requirements and design criteria, including analysis data.
2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
3. Indicate the Following on Reflected Ceiling Plans:

a. Ceiling penetrations and ceiling-mounted items.

b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
c. Method of attaching hangers to building structure.
d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

4. Indicate the Following on Occupied Work Area Plans:

a. Controls and alarms.
b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
c. Equipment and furnishings.

5. Indicate the Following on Access Floor Space Plans:

a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
b. Method of supporting piping.

6. Indicate the Following on Ceiling Plans:

a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
b. Method of supporting piping.
c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

1.4 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. Items Penetrating Finished Ceiling Include the Following:

a. Lighting fixtures.
b. Air outlets and inlets.

B. The installing contractor shall submit the following design information and drawings for approval prior to starting work on this project:

Field installation layout drawings having a scale of not less than 1/8 in. (3.2 mm) = 1 ft.- 0 in. (0.3 m) or 1:100 detailing the location of all agent storage tanks, nozzles, pipe runs, including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.

Auxiliary details and information such as maintenance panels, door holders, special sealing requirements, and equipment shutdown.

Separate layouts, or drawings, shall be provided for each level, (i.e.; room, sub floor, and above ceiling) and for mechanical and electrical work.

Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.

Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.

Separate drawing providing symbol legend and identifying all symbols used.

Annunciator wiring schematics and dimensioned display panel illustration shall be provided. (Optional device).

Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for all engineered clean agent systems. Calculation sheet(s) must include the manufacturer's name and UL listing number for verification. The individual sections of pipe and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.

Provide calculations for the battery stand-by power supply, taking into consideration the power requirements of all alarms, initiating devices, and auxiliary components under full load conditions.

A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay, and agent discharge for each zone or system.

C. Submit drawings, calculations and system component sheets for approval to the local fire prevention agency, owner's insurance underwriter, and all other authorities having jurisdiction before starting installation. Submit approved plans to the architect/engineer for record.

D. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

E. Seismic Qualification Certificates: For extinguishing-agent containers and control panels 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.

F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

1.6 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. Deliver extra materials to Owner.

1. Detection Devices: Not less than 20 percent of amount of each type installed.
2. Container Valves: Not less than 10 percent of amount of each size and type installed.
3. Nozzles: Not less than 20 percent of amount of each type installed.
4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.7 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. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."

C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

D. Installer:

The installing contractor shall be trained by the supplier to design, install, test, and maintain fire suppression systems.

When possible, the installing contractor shall employ a NICET certified special hazard designer, Level II or above, who will be responsible for this project.

The installing contractor shall be an experienced firm regularly engaged in the installation of automatic clean agent, or similar, fire suppression systems, in strict accordance with all applicable codes and standards.

The installing contractor must have a minimum of 5 years experience in the design, installation, and testing, of clean agent, or similar fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.

The installing contractor shall show evidence that his company carries a minimum $2 million liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.

The installing contractor shall maintain, or have access to, a clean agent recharging station. The installing contractor shall provide proof of his ability to recharge the largest clean agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

The installing contractor shall be an authorized stocking distributor of the clean agent system equipment so that immediate replacement parts are available from inventory.

The installing contractor shall show proof of emergency service available 24 hours a day, 7 days a week.

PART 2 - PRODUCTS

2.1 CLEAN-AGENT SYSTEMS

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:

1. Ansul Incorporated.
2. Chemetron Fire Systems; a UTC Fire & Security company.
3. Fike Corporation.
4. Orr Protection
5. Siemens Building Technologies, Inc.; Fire Safety Division.

B. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including any room cavity above the ceiling, below the ceiling, or below a raised floor. System shall include any separate zones above and/or below the ceiling or beneath the raised floor. If smoke is detected below a raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing

agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.

C. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

D. Performance Requirements: Discharge Novec 1230 within 10 seconds and maintain NFPA 2001 required percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.

E. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.

F. System Operating Sequence:

1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 15 seconds, and discharge extinguishing agent.
3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.

G. Manual stations shall immediately discharge extinguishing agent when activated.

H. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

I. EPO: Will terminate power to protected equipment immediately on actuation.

J. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

K. Seismic Performance: Fire-suppression piping and containers 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."

2.2 PIPING MATERIALS

A. See Novec 1230 Agent Piping Applications Article for applications of pipe, tube, fitting, and joining materials.

B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.3 PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A and Grade B; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.

1. Threaded Fittings:

a. Malleable-Iron Fittings: ASME B16.3, Class 300.
b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
c. Fittings Working Pressure: 620 psig minimum.
d. Flanged Joints: Class 300 minimum.

2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

B. 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.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

D. 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.

E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.4 VALVES

A. General Valve Requirements:

1. UL listed or FM Approved for use in fire-protection systems.
2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.5 EXTINGUISHING-AGENT CONTAINERS

A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.

1. Finish: Manufacturer's standard color, enamel or epoxy paint.
2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.6 FIRE-EXTINGUISHING CLEAN AGENT

A. Novec 1230 Clean Agent: Flourinated Ketone.

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. DuPont.
b. 3M

2.7 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

2.8 CONTROL PANELS & ALL WIRING

A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.

1. Mounting: Surface.

D. Supervised Circuits: Separate circuits for each independent hazard area.

1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
2. Manual pull-station circuit.

3. Alarm circuit.
4. Release circuit.
5. Abort circuit.
6. EPO circuit.

E. Control-Panel Features:

1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
2. Storage container, low-pressure indicator.
3. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.

G. Standby Power: Sealed lead calcium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.9 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 2001, NFPA 72, and UL 268.
2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.10 MANUAL STATIONS

A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

D. EPO Switch: "EPO" caption, with yellow finish.

2.11 SWITCHES

A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Low-Agent Pressure Switches: Pneumatic operation.
2. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.12 ALARM DEVICES

A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting.

B. Bells: Minimum 6-inch diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

2.13 ELECTRICAL POWER AND WIRING

A. Electrical power, wiring, and devices are specified in Division 26. Wiring shall be included in Novec 1230 installer scope.

2.14 GENERAL LIST OF DEVICES AND EQUIPMENT – Including but not limited to:

Fire-alarm/Suppression System Control Unit

Advanced Photoelectric Smoke Detectors

Ionization Smoke detector

Photoelectric Smoke detector

Thermal Detector

Flanged Detector Base

Flangeless Detector Base

Detector Base Adapter

Duct Housing

Addressable Monitor Module.

Addressable Alarm Line Module

Addressable Relay Module

Addressable Signal Module

Addressable Loop Module

Addressable Programmable Interface Card (APIC)

Isolator Modules

Remote Releasing Module

Addressable Manual Pull Station

Key Maintenance Switch

Multitone Horns and Multitone Horn-Strobes

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Novec 1230 agent piping applications

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

C. NPS 2-1/2 and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.3 CLEAN-AGENT PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

C. Install extinguishing-agent containers anchored to substrate.

D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."

1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
2. Support piping using supports and methods according to NFPA 13.
3. Install seismic restraints for extinguishing-agent containers and piping systems.
4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Division 28 Section "Digital, Addressable Fire-Alarm System".

3.5 IDENTIFICATION

A. Identify system components and equipment. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.

C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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. Tests and Inspections:

1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports. Provide as-built drawings for total system including O&M manuals.

3.7 CLEANING

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.8 SYSTEM FILLING

A. Preparation:

1. Verify that piping system installation is completed and cleaned.
2. Check for complete enclosure integrity.
3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicate charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.
4. Adjust operating controls.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

END OF SECTION 212200

SECTION 213113 - ELECTRIC-DRIVE, FIRE PUMP

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. Vertical In-line fire pump
2. Fire-pump accessories and specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire pumps 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."

B. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fire pumps, 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.

B. Product Certificates: For each fire pump, from manufacturer.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1.7 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 20, "Installation of Stationary Pumps for Fire Protection."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR HORIZONTAL SPLIT CASE FIRE PUMPS

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.2 FIRE PUMPS

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:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Corcoran Piping System Co.
3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
4. Peerless Pump, Inc.
5. Pentair Pump Group; Aurora Pump.
6. Pentair Pump Group; Fairbanks Morse.
7. Plad Equipment, Ltd.
8. Reddy-Buffaloes Pump Company.
9. S.A. Armstrong Limited.

B. Pump:

1. Standard: UL/FM pumps for fire service.
2. Type: Vertical In-line, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
    a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.

C. Coupling: None or rigid.

D. Driver:

1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Capacities and Characteristics:

1. Rated Capacity: 750 gpm.
2. Total Rated Head: 105 psi
3. Inlet Flange: Class 125.
4. Outlet Flange: Class 125.
5. Motor Horsepower: 75
6. Motor Speed: 3550.
7. Electrical Characteristics:
    a. Volts: 200
    b. Phase: Three.
    c. Hertz: 60.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

C. Relief Valves:

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:

a. BERMAD Control Valves.
b. CLA-VAL Automatic Control Valves.
c. Kunkle Valve; a part of Tyco International Ltd.
d. OCV Control Valves.
e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.

D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

F. Discharge Cone: Closed or open type.

G. Hose Valve Manifold Assembly:

1. Standard: Comply with requirements in NFPA 20.
2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:

a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
e. Escutcheon Plate: Brass or bronze; rectangular.
f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
g. Exposed Parts Finish: Polished brass.
h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

6. Manifold:

   a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
   b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
   c. Escutcheon Plate: Brass or bronze; round.
   d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
   e. Exposed Parts Finish: Polished brass.
   f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 FLOWMETER SYSTEMS

A. Description: Fire-pump flowmeter system that indicates flow to not less than 175 percent of fire-pump rated capacity, FM Approved. Include sensor of size to match pipe, tubing, flowmeter, and fittings.

1. Global Vision Inc., GVI-GAF Series or approved equal by one or these Manufacturers:
   a. Gerand Engineering Co.
   b. Preso Meters Corporation.

2. Pressure Rating: 500 PSIG.
3. Sensor: Venturi, annubar probe, or orifice plate, unless otherwise indicated.
4. Flowmeter: Compatible with flow sensor with dial not less than 4 inches in diameter or manufacturer's equivalent size.
5. Permanently Mounted Flowmeter: Suitable for wall mounting with copper tubing to connect to flow sensor.
6. Portable Flowmeter: With two 12-foot hoses, in carrying case.

2.5 PRESSURE GAGES

A. Description: UL 393, 3-1/2- to 4-1/2-inch diameter dial with range of 0- to 250-psig minimum. Include caption "WATER" on dial face.

1. Available]Manufacturers:

   a. AGF Manufacturing Co.
   b. AMETEK, Inc.; U.S. Gauge.
   c. Brecco Corporation.
   d. Dresser Equipment Group; Instruments Div.
   e. Marsh Bellofram.
   f. WIKA Instrument Corporation.
   g. Peerless

2.6 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

1. Verification of Performance: Rate fire pumps according to UL 448.

B. Fire pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.

B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.

B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases 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 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. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

D. Support piping and pumps separately so weight of piping does not rest on pumps.

E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems.

F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 21 Section "Wet-Pipe Sprinkler Systems.

G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.3 CONNECTIONS

A. Comply with requirements for piping and valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps and equipment to allow service and maintenance.

C. Connect relief-valve discharge to drainage piping or point of discharge.

D. Connect fire pumps to their controllers.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.5 FIELD QUALITY CONTROL

A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 21 Section "Controllers for Fire-Pump Drivers."

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. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
2. Test according to NFPA 20 for acceptance and performance testing.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 213113

SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Multistage, pressure-maintenance pumps.

B. Related Section:

1. Division 21 Section "Controllers For Fire-Pump Drivers" for pressure-maintenance-pump controllers.

1.2 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pumps, accessories, and specialties. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

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:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
3. PACO Pumps; Grundfos Pumps Corporation U.S.A.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.

C. Pump Construction:

1. Barrel: Stainless steel.
2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
3. Pump Head/Motor Mount: Cast iron.
4. Impellers: Stainless steel, balanced, and keyed to shaft.
5. Pump Shaft: Stainless steel.
6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
7. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
8. Chamber-Base Bearing: Tungsten carbide.
9. O-Rings: EPDM or NBR.

D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."

1. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet long.

E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

F. Capacities and Characteristics:

1. Rated Capacity: 15 gpm.
2. Total Dynamic Head: 110 psi
3. Working Pressure: 175-psig minimum.
4. Inlet and Outlet Size: NPS 1-1/4.
5. Discharge and Suction Flanges: Class 250.
6. Suction Head Available at Pump: 4 feet.
7. Motor Horsepower: 2
8. Motor Speed: 3500.
9. Electrical Characteristics:

    a. Volts: 208.
    b. Phases: Three.
    c. Hertz: 60.
    d. Full-Load Amperes: 3.
    e. Minimum Circuit Ampacity: 4.
    f. Maximum Overcurrent Protection: 15.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 21 Section "Common Motor Requirements for Fire Suppression 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. Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.

B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases 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 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.
5. Attach pumps to equipment base using anchor bolts.

C. Install multistage pressure-maintenance pumps according to HI 1.4.

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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 ADJUSTING

A. Lubricate pumps as recommended by manufacturer.

B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 213400

SECTION 213900 - CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Full-service, reduced-voltage controllers rated 600 V and less.
2. Controllers for pressure-maintenance pumps.

1.2 DEFINITIONS

A. ATS: Automatic transfer switch(es).

B. ECM: Electronic control module.

C. MCCB: Molded-case circuit breaker.

D. N.O.: Normally open.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-pump controllers and alarm panels 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."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Enclosure types and details for types other than NEMA 250, Type 2.
c. Factory-installed devices.
d. Nameplate legends.
e. Short-circuit current (withstand) rating of integrated unit.

f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
g. Specified modifications.

2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For each type of product indicated, 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.

C. Product Certificates: For each type of product indicated, from manufacturer.

D. Manufacturer's factory test reports of fully assembled and tested equipment.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

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. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.
2. Auxiliary Contacts: One for each size and type of magnetic contactor installed.
3. Power Contacts: Three for each size and type of magnetic contactor installed.

4. Contactor Coils: One for each size and type of magnetic controller installed.
5. Relay Boards: One for each size and type of relay board installed.
6. Operator Interface: One microprocessor board(s), complete with display and membrane keypad.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of an NRTL.

B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.

C. 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. Comply with standards of authorities having jurisdiction pertaining to materials and installation.

E. Comply with NFPA 20 and NFPA 70.

F. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS

A. Environmental Limitations:

1. Ambient Temperature Rating: Not less than 40 deg F and not exceeding 122 deg F unless otherwise indicated.
2. Altitude Rating: Not exceeding 6600 feet unless otherwise indicated.

B. Interruption of Existing Electric Service: Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

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:

1. Aquarius Fluid Products, Inc.
2. ASCO Power Technologies, LP; Firetrol Products.
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Hubbell Incorporated; Hubbell Industrial Controls.
5. Joslyn Clark Corporation.
6. Master Control Systems, Inc.
7. Metron, Inc.
8. Tornatech.

B. General Requirements for Full-Service Controllers:

1. Comply with NFPA 20 and UL 218.
2. Listed by an NRTL for electric-motor driver for fire-pump service.
3. Combined automatic and nonautomatic operation.
4. Factory assembled, wired, and tested; continuous-duty rated.
5. Service Equipment Label: NRTL labeled for use as service equipment.

C. Method of Starting:

1. Pressure-switch actuated.
    a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
    b. System pressure recorder, electric ac driven, with spring backup.
    c. Programmable minimum-run-time relay to prevent short cycling.
    d. Programmable timer for weekly tests.
2. Solid-State Controller: Reduced-voltage type.
3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.

D. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting.

E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

G. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:

    a. Microprocessor-based logic controller, with multiline digital readout.
    b. Membrane keypad.
    c. LED alarm and status indicating lights.

3. Local Alarm and Status Indications:

    a. Controller power on.
    b. Motor running condition.
    c. Loss-of-line power.
    d. Line-power phase reversal.
    e. Line-power single-phase condition.
    f. Selector switch not in Auto.

4. Audible alarm, with silence push button.
5. Nonautomatic START and STOP push buttons or switches.

H. Optional Features:

1. Extra Output Contacts:

    a. One N.O. contact(s) for motor running condition.
    b. One set(s) of contacts for loss-of-line power.
    c. One N.O. contact(s) Line-power phase reversal.
    d. One N.O. contact(s) Controller power on.
    e. One N.O. contact(s) Selector switch not in auto.

2. Local alarm bell.
3. Operator Interface Communications Ports: USB, Ethernet, and RS485.

I. ATS:

1. Complies with NFPA 20, and [UL 1008.
2. Integral with controller as a listed combination fire-pump controller and power transfer switch.
3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
4. Allows manual transfer from one source to the other.
5. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
6. Local Alarm and Status Indications:

    a. Normal source available.
    b. Alternate source available.
    c. In normal position.
    d. In alternate position.

e. Isolating means open.

7. Audible alarm, with silence push button.
8. Nonautomatic (manual, nonelectric) means of transfer.
9. Engine test push button.
10. Start generator output contacts.
11. Timer for weekly generator tests.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

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:

1. Aquarius Fluid Products, Inc.
2. ASCO Power Technologies, LP; Firetrol Products.
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Hubbell Incorporated; Hubbell Industrial Controls.
5. Joslyn Clark Corporation.
6. Master Control Systems, Inc.
7. Metron, Inc.
8. Tornatech.

B. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
3. Factory assembled, wired, and tested.
4. Finish: Manufacturer's standard color paint.

C. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch.
2. Pressure switch.
3. Hand-off-auto selector switch.
4. Pilot light.
5. Running period timer.

2.3 ENCLOSURES

A. Fire-Pump Controllers and ATS: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
1. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2.

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".

C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

D. Optional Features:

1. Floor stands, 12 inches high, for floor-mounted controllers.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20.

1. Verification of Performance: Rate controllers according to operation of functions and features specified.

B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROLLER INSTALLATION

A. Install controllers within sight of their respective drivers.

B. Connect controllers to their dedicated pressure-sensing lines.

C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall.

D. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor.

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.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Comply with NEMA ICS 15.

3.3 POWER WIRING INSTALLATION

A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONTROL AND ALARM WIRING INSTALLATION

A. Install wiring between controllers and remote devices and facility's central monitoring system. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Control-Voltage Electrical Power Cables."

B. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 28 Section "Digital, Addressable Fire-Alarm System."

C. Bundle, train, and support wiring in enclosures.

D. Connect remote manual and automatic activation devices where applicable.

3.5 IDENTIFICATION

A. Comply with requirements in NFPA 20 for marking fire-pump controllers.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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. Inspect and Test Each Component:

a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
c. Test continuity of each circuit.

2. Verify and Test Each Electric-Driver Controller:

a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify [Architect] [Construction Manager] [Owner] before starting the motor(s).
b. Test each motor for proper phase rotation.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Construction Manager and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

F. Controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

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. Adjust controllers to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. 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.

D. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers 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, and maintain controllers and to use and reprogram microprocessor-based controls within this equipment.

END OF SECTION 213900

SECTION 21 13 21 - FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

The Contractor shall procure and furnish all labor, materials, tools and equipment required for the installation of fire suppression systems for the gasoline fueling systems, as indicated on the Contract Drawings or as directed by the Construction Manager.

1.2 RELATED WORK:

SECTION 23 13 13:	FACILITY UNDERGROUND FUEL STORAGE TANKS
SECTION 40 22 00:	PETROLEUM PRODUCTS PIPING
SECTION 40 70 00:	INSTRUMENTATION FOR PROCESS SYSTEMS

1.3 APPLICABLE REFERENCES:

The following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation and shall be the latest published versions.

A. National Fire Protection Association

NFPA 17 Standard for Dry Chemical Extinguishing Systems

NFPA 30 Flammable and Combustible Liquids Code

B. Underwriter's Laboratory

U.L. 1254 Standard for Pre-Engineered Dry Chemical Extinguishing System Units

1.4 SUBMITTALS:

A. The Contractor shall submit manufacturer's specifications, catalog cuts indicating material type, etc., installation instructions, and test results.

B. The Contractor shall submit manufacturer's certification that product is compatible with E85 gasoline.

C. Working Drawings:

1. Working drawings shall be submitted to the Construction Manager for approval before the work commences. The working drawings shall clearly indicate the locations and relationship of all equipment, piping, supports, and appurtenances. The drawings shall be fully dimensioned to determine the suitability of the installation.

2. The working drawings shall include a complete and comprehensive bill of materials keyed to the drawings. The bill of materials shall provide all information to determine compliance with the Contract Drawings and Specifications.

3. The Contractor is responsible for verifying all dimensions in the field and for insuring that interferences do not exist between the Contractor's work and the surroundings.

4. Any deviations from the Contract Drawings because of physical interferences, substitutions, of filed verification shall be clearly indicated on the working drawings.

1.5 ALTERATIONS TO ACCOMMODATE EQUIPMENT:

The Contract Drawings indicate a typical installation based on a certain make or brand of equipment, and are not to be construed as representing the layout for any other make or brand. Any alterations which are necessary to adequately and satisfactorily accommodate the equipment to be installed under this Contract shall be made by the Contractor at his own expense, in accordance with the Contract and Specifications and subject to approval by the Construction Manager.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The fire extinguishing system shall be the stored pressure dry chemical pre-engineered fixed nozzle type as manufactured by Johnson Controls, or an approved equal. The system shall provide for protection of the gasoline vehicle fueling areas described and defined in the Contract Drawings.

B. The system shall be capable of automatic and manual actuation. It shall be tested in accordance with UL 1254 and be listed by Underwriters Laboratories. The system shall be installed and maintained in accordance with NFPA 17, NFPA 30, the manufacturer's UL Listed Technical Manual, and all local and/or State Codes and Standards.

C. The system shall be designed for operation at ambient temperatures from -40° F to 120° F (-40° C to 49° C).

D. The system shall be designed for operation in a minimum 10 mile per hour wind.

2.2 CYLINDER AND AGENT

A. Agent. The extinguishing agent shall be Pyro-Chem monoammonium phosphate-based dry chemical agent (ABC type) or an approved equal.

B. Cylinders. Steel cylinders manufactured, tested, and marked in accordance with DOT 4BW350 shall be used to store the extinguishing agent. Pyro-Chem Cylinder Model ATD-75 or an approved equal shall be used with extinguishing agent fill weight of 75 lbs. All cylinders shall be charged with dry nitrogen to 350 psig at 70° F.

C. Cylinder valve. A pressure sealed poppet-type valve having a brass body, stainless steel stem with rubber seat washer, fusible safety relief assembly, and pressure gauge shall be used on all agent cylinders.

D. Cylinder bracketing. Cylinders shall be mounted vertically. The cylinders shall be secured by use of a steel mounting bracket affixed to a rigid bracket capable of supporting the weight of the filled cylinder and the concussion of cylinder discharge.

2.3 ACTUATION CONTROLS

A. Control Head. The system control head shall include a Model ECH-Series Control Head as manufactured by Johnson Controls, or an approved equal. The control head shall be mounted directly on the valve of a pneumatic actuating cylinder. A carbon dioxide pilot cartridge that complies with MIL-C0601G shall be used as an integral component of the control head. Control head status shall be visually indicated by a SET/FIRED indicator.

B. Detection. The ambient temperature of the hazard area shall be monitored by fixed temperature electrical thermal detectors. When the temperature of the hazard area exceeds the rating of any detector, the detector shall close a normally open switch element within the

detector, sending a signal to the control head. This signal shall energize a solenoid in the control head which exercises the control head and actuates the system.

C. Pneumatic actuation. The system shall have a PAC-Series Pneumatic Actuating Cylinder as manufactured by Johnson Controls, or an approved equal. The PAC cylinder shall have a valve that opens upon activation of the control head. The valve shall release nitrogen from the PAC cylinder into the pneumatic pipe and tubing network. This nitrogen shall depress a piston above the valve stem in each agent cylinder, opening each agent cylinder valve and releasing the pressurized agent.

D. Manual actuation. The system shall have mechanical manual actuation capability requiring no electrical power. This is accomplished locally by twisting the handle on the cover of the ECH-Series Control Head, or remotely by means of a Model RPS-M remote mechanical pull station as manufactured by Johnson Controls, or an approved equal.

E. Auxiliary output. The system shall shut off power to all fuel dispensing units in the event of system actuation. This is accomplished by means of dry contacts on a Model MS-DPDT micro switch as manufactured by Johnson Controls, or an approved equal, installed in the ECH-Series Control Head. The micro switch may also be used for auxiliary functions such as audible alarms or alarm signaling.

F. Supervision. A Model SM Series Solenoid Monitor as manufactured by Johnson Controls, or an approved equal, shall be used to supervise the integrity of all electrical actuation circuits, whether automatic or manual.

G. Manual electrical actuation (optional). The system can have electrical manual actuation capability. This is accomplished by the use of a Model RPS-E2 Remote Electrical Pull Station as manufactured by Johnson Controls, or an approved equal, installed in the automatic detection circuit.

2.4 DISTRIBUTION NOZZLES

A. Nozzles. The system shall utilize Model N-ATD Discharge Nozzles as manufactured by Johnson Controls, or an approved equal, to distribute agent throughout the hazard area. The quantity, location, and orientation of nozzles shall be in accordance with Pyro-Chem, “The Attendant Gasoline Station Fire Suppression System Technical Manual”, Part No. 550670, latest revision.

B. Nozzle covers. All nozzles shall be installed with nozzle covers to prevent foreign matter from clogging the discharge nozzles.

2.5 PIPE AND FITTINGS

A. Pipe. All pipe shall be Schedule 40 black, galvanized, chrome plated or stainless steel pipe in compliance with NFPA 17. All pipe ends shall be thoroughly reamed after cutting, and all oil, chips, and debris shall be removed prior to nozzle installation.

B. Fittings. Standard weight malleable, galvanized, chrome plated or stainless steel fittings shall be used.

C. Size. All system pipe and fittings will be sized in accordance with the system Technical Manual. No substitutions are allowed.

D. Joints. No joint sealant shall be used in the discharge piping. Exception: Teflon tape may be used to ensure a snug fit.

E. Straps. All system discharge pipe shall be securely fastened by means of pipe hangers and/or pipe straps. UL listed pipe hangers shall be used.

F. Union. A union shall be installed in the discharge piping conveniently close to the cylinder valve to permit disconnection for inspection and service.

PART 3 - EXECUTION

3.1 INSTALLATION:

All equipment shall be installed in accordance with the Manufacturer's instructions.

END OF SECTION 21 13 21

NO TEXT ON THIS PAGE

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 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.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) 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.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium 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**] <**Insert number**> 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**.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: **Ratings, characteristics, and features coordinated with and approved by controller manufacturer.**

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

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 (Not Applicable)

END OF SECTION 220513

SECTION 220516 – EXPANSION FITTINGS AND LOOPS 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. Metal-bellows packless expansion joints.
   2. Pipe loops and swing connections.
   3. Alignment guides and anchors.

1.3 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.

1.4 ACTION 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 the qualified professional engineer responsible for their preparation.

   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing 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: 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.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 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.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Metal-Bellows Packless Expansion Joints:

1. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
2. Type: Circular, corrugated bellows with external tie rods.
3. Minimum Pressure Rating: 150 psig unless otherwise indicated.
4. Configuration: Single joint with base and double joint with base classes unless otherwise indicated.
5. Expansion Joints for Copper Tubing: Multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Adsco 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.

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.

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 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 five pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guides on each side of pipe expansion fittings and loops. 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 Black-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 Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
3. 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 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 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.

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-inch annular clear space between piping and concrete slabs and walls.

C. 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 1/4-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."

D. 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.

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-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 AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Natural gas piping sleeve (e.g. wall, and slab) shall be installed per National Gas Specifications. Refer to section 231123 facility natural gas piping.

2. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b.

3. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

5. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

6. Interior Partitions:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

SECTION 220519 - METERS AND GAGES 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. Liquid-in-glass thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Test plugs.
   5. Test-plug kits.

B. Related Sections:
   1. Division 22 Section "Facility Water Distribution Piping" for domestic water meters.
   2. Division 22 Section "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:

a. Trerice, H. O. Co.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Adjustable angle.
5. Tube: Glass with magnifying lens and red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range.

2.2 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, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 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.

2.3 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:

   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   e. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with [NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products 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.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products 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.

B. Furnish one test-plug kit containing one 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.

C. High-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F and minus 18 to plus 104 deg C.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig and 0 to 1380 kPa.

E. Carrying Case: Metal or plastic, with formed instrument padding.

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 direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Compact-style, liquid-in-glass type.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:

   1. Liquid-filled Sealed, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

   1. Liquid-filled Sealed, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:

   1. Liquid-filled Sealed, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi and 0 to 600 kPa.

B. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.

END OF SECTION 220519

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.

1.2 SUMMARY

A. Section Includes:
   1. Ball Valves.
   2. Check Valves.
   3. Gate Valves.
   4. Globe Valves

B. Related Sections:
   1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

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 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating each valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

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. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. 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.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BALL VALVES

A. BRONZE BALL VALVES
1. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

3. 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. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.3 CHECK VALVE

A. BRONZE SWING CHECK VALVES
1. Class 125, Bronze Swing Check Valves with Bronze Disc:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

3. 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. Ends: Threaded.
   f. Disc: Bronze.

B. IRON SWING CHECK VALVES
1. Class 125, Iron Swing Check Valves with Metal Seats:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
3. 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.

C. IRON GLOBE CENTER-GUIDED CHECK VALES:
1. Class 125, Iron Globe Center-Guided Check Valves with Metal Seat
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Flomatic Corporation.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
3. Description:
   a. Standard: MSS SP-125.
   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 126, gray iron.
   e. Style: Globe, spring loaded.
   f. Ends: Flanged.
   g. Seat: Bronze.

2.4 GATE VALVE

A. IRON GATE VALVES
1. Class 125, NRS, Iron Gate Valves
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. Hammond Valve.

c. Milwaukee Valve Company.
d. NIBCO INC.

3. Description:
a. Standard: MSS SP-70, 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. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.5 GLOVE VALVES

A. BRONZE GLOBE VALVES
1. Class 125, Bronze Globe Valves with Bronze Disc:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Stockham Division.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
3. 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 or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable aluminum.

B. IRON GLOBE VALVES
1. Class 125, Iron Globe Valves:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Stockham Division.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
3. Description:
a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.6 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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 valve stems.
3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
4. Chain: Stainless 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, gate, and globe valves NPS 4 and larger and more than 96 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 Check Valves: In horizontal or vertical position, between flanges.

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 VALVE SCHEDULE

VALVE SCHEDULE			
System	Pipe Size (inch)	Service	Valve Type
Domestic Cold Water, Hot Water and Hot Water Return	Up to 2	Shutoff	Bronze Ball
		Check	Bronze Swing Check
		Throttling	Bronze Globe
		Pump Discharge Check Valve	Bronze Swing Check
	2 ½ to 6	Shutoff	Iron Gate
		Check	Iron Swing
		Throttling	Iron Globe
		Pump Discharge Check Valve	Iron Center Guided Check

END OF SECTION 220523

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. Pipe Hangers and Supports.
   2. Inserts.
   3. Fastener Systems.
   4. 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 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
   3. Division 22 Section "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 and obtain approval from authorities having jurisdiction.

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Pipe Hangers and Supports.
   2. Inserts.
   3. Fastener Systems.
   4. 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.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 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 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 stainless steel.

B. TRAPEZE PIPE HANGERS:
   1. 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.

C. METAL FRAMING SYSTEMS

1. MFMA Manufacturer Metal Framing Systems:
2. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Standard: MFMA-4.
5. Channels: Continuous slotted steel channel with inturned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
8. Metallic Coating: Hot-dipped galvanized.

2.2 INSERTS

A. THERMAL-HANGER SHIELD INSERTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Carpenter & Paterson, Inc.
    b. Clement Support Services.
    c. ERICO International Corporation.
    d. National Pipe Hanger Corporation.
    e. PHS Industries, Inc.
    f. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
    g. Piping Technology & Products, Inc.
    h. Rilco Manufacturing Co., Inc.
    i. Value Engineered Products, Inc.

2. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
3. Insulation-Insert Material for Hot Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
4. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
5. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.
6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 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, 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.

2.4 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. 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.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. 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.

I. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

J. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

K. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

L. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

M. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

N. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

O. Use stainless-steel pipe hangers, and fiberglass pipe hangers and fiberglass strut systems and stainless-steel attachments for hostile environment applications.

P. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

Q. 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.

R. 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.
    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.

S. 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.

T. 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.

U. Pipe Hanger, Support, Spacing, & Rod Schedule

CW: Cold Water

HW: Hot Water

HWR: Hot Water Return

S: Sanitary

V: Vent

SD: Storm Drain

Pipe Support Schedule			
System	Pipe Support Service	Pipe Support Type	Standard
CW, HW, HWR, S, V, and SD	Hanger	Horizontal 100 feet and less: Adjustable, Steel Clevis Hanger	MSS Type 1
		Horizontal longer than 100 feet: Adjustable, Steel Clevis Roller Hanger	MSS Type 43
	Floor	Floor Support: Steel-pipe base stanchion support and cast-iron floor flange, and with U-bolt to retain type.	MSS Type 37
	Wall Support Indoor	Welded-Steel Bracket	MSS Type 31 – 750 lb MSS Type 32 – 1,500 lb MSS Type 33 – 3,000 lb
	Vertical Piping Clamps Indoor	Carbon Steel Riser Clamps	MSS Type 42
	Multiple Pipe	Horizontal 100 feet and less: Trapeze Pipe Hanger	MSS SP-59
		Horizontal longer than 100 feet: Trapeze Pipe Hanger with pipe rolls	MSS Type 44 & MSS SP-59

Pipe Hanger Spacing & Rod Schedule				
Pipe Material	Pipe Size (inch)	Maximum Horizontal Spacing (feet)	Maximum Vertical Spacing (feet)*	Rod (inch)
Copper	½ to 1 ½	6	10	3/8Ø
	2	8	10	1/2Ø
	2 ½ to 3	10	10	5/8Ø
Ductile Iron	4	5**	10	3/4Ø
Cast Iron	1 ½ to 2	5**	15	3/8Ø
	3	5**	15	5/8Ø
	4	5**	15	5/8Ø

* In addition, vertical piping shall be supported at each floor.

**Maximum horizontal spacing of pipe hanger shall be increased to 10 feet where 10-foot lengths of pipe are installed.

3.2 INSERT INSTALLATION – THERMAL-HANGER SHIELD:

1. Install in pipe hanger and shield for insulated piping.
2. Insulated Piping:
   a. Attach clamps and spacers to piping.
      1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
3. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
4. 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.

5. 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.

6. 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.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 FASTENER INSTALLATION

1. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
2. 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.
3. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
4. 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.

3.4 METAL FABRICATIONS

A. Comply with MFMA-103 for metal framing system

B. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hanger.

C. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

D. 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.

3.5 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.

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 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220548 – VIBRATION AND SEISMIC CONTROLS 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. This Section includes the following:

1. Isolation pads.
2. Housed spring mounts.
3. Pipe riser resilient supports.
4. Resilient pipe guides.
5. Seismic Restraint Devices

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind Loading:
1. Basic Wind Speed: 120 MPH
2. Exposure Category: B
3. Importance Factor: 1.15 For all MEP Systems

B. Seismic-Restraint Loading:
1. Seismic Importance Factor: 1.5 For all MEP Systems
2. Occupancy Category: IV
3. Spectral Response Accel. (SS): 0.30g
4. Spectral Response Accel. (S1): 0.07g
5. Spectral Response Coeff. (SDS): 0.31g
6. Spectral Response Coeff. (SD1): 0.11g
7. Response Modification Factor (R): 4.0
8. Seismic Design Category: C
9. Site Class: D
10. Seismic Response Coefficient (CS): 0.16

11. Basic Seismic Force Resisting System: Ordinary Precast Shear Walls
12. Analysis Procedure: Equivalent Lateral Force
13. Design Base Shear: 451K

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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. Kinetics Noise Control.
2. Mason Industries.
3. Vibration Mountings & Controls, Inc.

C. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

D. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inchtravel up or down before contacting a resilient collar.

E. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

F. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

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. Kinetics Noise Control.
3. Mason Industries.

C. 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.

D. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. General:
   1. All equipment, and piping shall be restrained to resist seismic forces per the applicable building codes as a minimum.
   2. Install seismic restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
   3. Attachment to structure for suspended equipment, and pipe: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
   4. Provide hanger rod stiffeners where required to prevent buckling of rods due to seismic forces.
   5. Where rigid restraints are used on equipment or piping, the support rods for the equipment or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.
   6. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Equipment Restraints:
   1. All plumbing equipment shall be seismically restrain. Install fasteners, straps and brackets as required to secure the equipment.

2. Install seismic snubbers on plumbing equipment supported by floor-mounted, non-seismic vibration isolators. Position snubbers as necessary and attach to equipment base and supporting structure as required.
3. Install neoprene grommet washers or fill the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inch.
4. Suspended Equipment: All suspended plumbing equipment shall be seismically restrained per section 3.5 vibration isolation & seismic control schedule.
5. Base Mounted Equipment: All base mounted plumbing equipment shall be seismically restrained per section 3.5 vibration isolation & seismic control schedule.

C. Piping Restraints Installation:

1. Comply with requirements in MSS SP-127.
2. Brace a change of direction longer than 12 feet.
3. Branch lines may not be used to brace main lines.
4. The 12" Rule: No restraints will be required for piping that meets the requirements of the 12" Rule for the entire piping run. The 12" Rule will be said to apply to a piping run if:
   a. The piping is supported by rog hangers.
      1) For single clevis supported pipe, all of the hangers in the piping run are 12 in. or less in length from the top of the pipe to the supporting structure.
      2) For trapeze supported pipe, all of the hangers in the piping run are 12 in. or less in length from the top of the trapeze bar to the supporting structure.
   b. The hanger rods and their attachments are not to be subjected to moments (i.e. the connection between the hanger and the supporting structure to be "non-moment generating; the connector must be one that allows the piping run to swing freely on its hanger without introducing bending moment in the hanger).
   c. There must be sufficient space around the piping run to accommodate the expected motion of the pipe as it sways back and forth with the earthquake motion in the building.
   d. Connections between the piping and interfacing components must be designed and/or selected to accept the full range of motion expected for both the pipe and the interfacing component.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 VIBRATION ISOLATION & SESIMIC CONTROLS SCHEDULE

Plumbing Equipment Vibration Isolation			
Equipment	Base Type	Isolator Type	Minimum Deflection (inch)
Gas Fired Domestic Hot Water Heater	Concrete Pad	Neoprene Pad	¼
Hot Water Return Pump	N/A	N/A	N/A
Sump Pump	N/A	N/A	N/A
Packaged Cold Water Booster Pump	Factory Skid & Concrete Pad	House Spring Isolator	¾

Plumbing Equipment Seismic Control		
Equipment	Equipment Installation	SeismicRestraint Required
Gas Fired Domestic Hot Water Heater	Base Mounted Equipment	Yes
Hot Water Return Pump	Suspended Equipment	Yes
Sump Pump	Base Mounted Equipment	Yes
Packaged Cold Water Booster Pump	Base Mounted Equipment	Yes

*Plumbing Piping Seismic Control

Plumbing Pipe Type	Location	Plumbing Pipe Material	Pipe Size (inch)	Seismi Restraint Required	Maximum Transverse Support (Ft O.C.)	Maximum Longitudinal Support (Ft O.C.)
All	MER	Ductile & Non Ductile	1 and smaller	No	N/A	N/A
		Ductile	1 ¼ and larger	Yes	40	80
		Non Ductile		Yes	20	40
All	All location (besides MER)	Ductile & Non Ductile	2 and smaller	No	N/A	N/A
		Ductile	2 ½ and larger	Yes	40	80
		Non Ductile		Yes	20	40
Gas	All location (besides MER)	Steel, Schedule 40	¾ and smaller	No	N/A	N/A
			1 and larger	Yes	20	40

*For pipe risers, restrain the piping at floor penetrations using the same spacing requirement as above.

Component Amplification and Response Modification Factors		
Components	a_P	R_P
Equipment: Hot Water Heaters, Pumps	1.0	2.5
Vibration Isolated Component & Systems:		
i. Spring isolated components & systems & vibration isolated floors closely restrained.	i. 2.5	i. 2.0
ii. Internally isolated components or systems	ii. 2.5	ii. 2.0
iii. Suspended isolated equipment & internally isolated components	iii. 2.5	iii. 2.5
Distribution Systems		
i. Piping & Tubing, this includes in-line components, constructed of high or limited deformability materials with joints made by threading, bonding, compression couplings, or grooved couplings	i. 2.5	i. 6.0
ii. Piping & Tubing of low deformability materials, such as cast iron, glass, or non ductile plastics	ii. 2.5	ii. 3.0
Other Components Not Listed	1.0	1.5

3.6 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. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Verify snubber minimum clearances.
7. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
8. Air-Mounting System Operational Test: Test the compressed-air leveling system.
9. Test and adjust air-mounting system controls and safeties.
10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

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 ACTION 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: Aluminum, 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. 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, 1/16 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.

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 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 for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel> black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd 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 letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Aluminum, 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, on 18-by-24-inch 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: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire or string.
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 "Interior Painting."

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:

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 Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: Green.
b. Letter Color: White.

2. Sanitary, Vent, and Storm Drainage Piping:

a. Background Color: Green.
b. Letter Color: White.

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. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, round <Insert shape>.
b. Hot Water: 1-1/2 inches, round <Insert shape>.

2. Valve-Tag Color:

a. Cold Water: Natural.
b. Hot Water: Natural.

3. Letter Color:

a. Cold Water: Black.
b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING 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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

1.5 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping 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.

1.8 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 "Piping Insulation Schedule 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.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree 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 with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   b. Eagle Bridges - Marathon Industries; 501.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 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.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Pittsburgh Corning Corporation; Pittwrap.
    b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 491 AWF FSK.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    c. Compac Corporation; 110 and 111.
    d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.

3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.
e. .

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
c. .

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. 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.

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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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.

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 o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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. Cleanouts.

3.4 PENETRATIONS

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A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 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, 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 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. 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. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

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. Instead, 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.
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.

3.7 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.

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.

3.8 FINISHES

A. 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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.9 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 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, , two locations of threaded 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.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.

B. PIPING INSULATION SCHEDULE

CW: Domestic Cold Water

HW: Domestic Hot Water

HWR: Domestic Hot Return

SD: Storm Drain (Primary & Secondary)

INDOOR PIPE INSULATION SCHEDULE					
System	Visibility	Insulation Material	Jacket	Pipe Size (inch)	Insulation Thickness (inch)
CW	Conceal	Pre-formed Glass Fiber Type I	None	Up to 1 ½ 2 to 6	1 1 ½
	Expose	Pre-formed Glass Fiber Type I	Factory Applied Jacket	Up to 1 ½ 2 to 6	1 1 ½
HW & HWR	Conceal	Pre-formed Glass Fiber Type I	None	Up to 1 ½ 2 to 6	1 ½ 2
	Expose	Pre-formed Glass Fiber Type I	Factory Applied Jacket	Up to 1 ½ 2 to 6	1 1 ½
SD	Conceal	Pre-formed Glass Fiber Type I	None	Up to 6	2
	Expose	Pre-formed Glass Fiber Type I	Factory Applied Jacket	Up to 6	2

*All exposed piping below sink shall be provided with ADA protective shield guard (Refer to section 2.9).

OUTDOOR PIPE INSULATION SCHEDULE

System	Visibility	Insulation Material	Jacket	Pipe Size (inch)	Insulation Thickness (inch)
CW	Underground	Pre-formed Glass Fiber Type I	Field Applied Jacket	Up to 1 ½ 2 to 6	1 1 ½
HW & HWR	N/A				
SD	Underground	Pre-formed Glass Fiber Type I	Field Applied Jacket	Up to 6	2

END OF SECTION 220719

SECTION 221113 – FACILITY WATER DISTRIUBTION 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. This Section includes water-distribution piping and related components outside the building forwater service, and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:
1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Flanges: ASME 16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints:

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. EBAA Iron, Inc.
b. U.S. Pipe and Foundry Company.

3. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

a. Pressure Rating: 250 psig minimum.

B. Ductile-Iron Flexible Expansion Joints:

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. EBAA Iron, Inc.
b. Hays Fluid Controls; a division of ROMAC Industries Inc.
c. Star Pipe Products.

3. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

a. Pressure Rating: 250 psig (1725 kPa) minimum.

C. Ductile-Iron Deflection Fittings:

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. EBAA Iron, Inc.

3. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

a. Pressure Rating: 250 psig minimum.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

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. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. Hays Fluid Controls; a division of ROMAC Industries Inc.
e. JCM Industries.
f. Smith-Blair, Inc.
g. Viking Johnson.

3. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.
b. Center-Sleeve Material: Manufacturer's standard.
c. Gasket Material: Natural or synthetic rubber.
d. Pressure Rating: 150 psig (minimum.
e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

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. Victaulic Depend-O-Lok.

3. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

a. Standard: AWWA C219.
b. Sleeve Material: Manufacturer's standard].
c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
e. Pressure Rating: 150 psig minimum.
f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. 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. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig minimum at 180 deg F.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    a. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 125 psig minimum at 180 deg F.
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

    a. Description:

        1) Nonconducting materials for field assembly of companion flanges.
        2) Pressure Rating: 150 psig.
        3) Gasket: Neoprene or phenolic.
        4) Bolt Sleeves: Phenolic or polyethylene.
        5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

    a. Description:

        1) Standard: IAPMO PS 66
        2) Electroplated steel nipple complying with ASTM F 1545.
        3) Pressure Rating: [300 psig at 225 deg F>.
        4) End Connections: Male threaded or grooved.
        5) Lining: Inert and noncorrosive, propylene.

2.5 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Tube.
3. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
4. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
5. Color: Black.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

a. American AVK Co.; Valves & Fittings Div.
b. American Cast Iron Pipe Co.; American Flow Control Div.
c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. East Jordan Iron Works, Inc.
f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
g. McWane, Inc.; Kennedy Valve Div.
h. McWane, Inc.; M & H Valve Company Div.
i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
j. Mueller Co.; Water Products Div.
k. NIBCO INC.
l. U.S. Pipe and Foundry Company.

4. OS&Y, Rising-Stem, Metal-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.

1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

    a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
    b. East Jordan Iron Works, Inc.
    c. Flowserve.
    d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    e. McWane, Inc.; Kennedy Valve Div.
    f. McWane, Inc.; M & H Valve Company Div.
    g. Mueller Co.; Water Products Div.
    h. U.S. Pipe and Foundry Company.

4. Description: Sleeve and valve compatible with drilling machine.

    a. Standard: MSS SP-60.
    b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
    c. Valve: AWWA, cast-iron, nonrising-stem, metal-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 CHECK VALVES

A. AWWA Check Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

    a. American AVK Co.; Valves & Fittings Div.
    b. American Cast Iron Pipe Co.; American Flow Control Div.
    c. APCO Williamette; Valve and Primer Corporation.

d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
g. McWane, Inc.; Kennedy Valve Div.
h. McWane, Inc.; M & H Valve Company Div.
i. Mueller Co.; Water Products Div.
j. NIBCO INC.
k. Watts Water Technologies, Inc.

4. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.
b. Pressure Rating: 175 psig.

2.9 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

a. DeZURIK/Copes-Vulcan; a unit of SPX Corporation.
b. Milliken Valve Company.
c. Mosser Valve; a division of Olson Technologies, Inc.
d. Mueller Co.; Water Products Div.
e. Pratt, Henry Company.
f. Val-Matic Valve & Manufacturing Corp.

4. Description: Rubber seated.

a. Standard: AWWA C504.
b. Body: Cast or ductile iron.
c. Body Type: Flanged.
d. Pressure Rating: 150 psig (1035 kPa).

2.10 PLUG VALVES

A. Plug Valves:

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:

3. Basis-of-Design Product: Subject to compliance with requirements, provide t by one of the following:

    a. DeZURIK/Copes-Vulcan; a unit of SPX Corporation.
    b. Homestead Valve; a division of Olson Technologies, Inc.
    c. Milliken Valve Company.
    d. McWane, Inc.; M & H Valve Company Div.
    e. Pratt, Henry Company.
    f. Val-Matic Valve & Manufacturing Corp.

4. Description: Resilient-seated eccentric.

    a. Standard: MSS SP-108.
    b. Body: Cast iron.
    c. Pressure Rating: 175-psig minimum CWP.
    d. Seat Material: Suitable for potable-water service.

2.11 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

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. Amcast Industrial Corporation; Lee Brass Co.
    b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
    c. Jones, James Company.
    d. Master Meter, Inc.
    e. McDonald, A. Y. Mfg. Co.
    f. Mueller Co.; Water Products Div.
    g. Red Hed Manufacturing & Supply.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with

lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.12 WATER METERS

A. Water meters will be furnished by utility company.

B. Manufacturers:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:
   a. Badger Meter, Inc. (Basis of Design) – Model Recordall Compound Series Meter
   b. Carlon Meter.
   c. Hays Fluid Controls; a division of ROMAC Industries Inc.
   d. McCrometer.
   e. Mueller Co.; Hersey Meters.
   f. Neptune Technology Group Inc.
   g. Sensus Metering Systems.

C. Compound-Type Water Meters:

1. Manufacturer: Badger Meter, Inc

2. Model: Recordall Compound Series Meter

3. Meter Flanges, Class 150: 4” round

4. Typical Operating Range: 0.75 to 1000 gpm

5. Low Flow Registration: 0.375 gpm

6. Pressure Loss at Continuous Flow: 11.0 psi

7. Maximum Operating Pressure: 150 psi

8. Maximum Operating Temperature: 105°f

9. Test Plug: 2 inch

10. Materials
    a. Meter Housing & Cover: Lead Free Bronze Alloy
    b. Turbo Cast Head: Lead Free Bronze Alloy
    c. Nose Cone & Straightening Vanes: Thermoplastic

d. Rotor: Thermostatic.
e. Rotor Radial Bearings: Lubricated thermoplastic
f. Rotor Thrust Bearing: Sapphire Jewels
g. Rotor Bearing Pivots: Passivated 316 stainless steel
h. Calibration Mechanism: Stainless steel & thermoplastic
i. Measuring Chamber & Disc: Thermoplastic
j. High Flow Valve: Stainless Steel & thermoplastic
k. Magnets: Ceramic
l. Register Lens: Glass
m. Register Housing & Cover: Bronze
n. Trim: Stainless Steel
o. Drain Plug (3/4"): Stainless Steel
p. Test Plug: Stainless Steel
q. Standard: AWWA C702.
r. Registration: Flow in gallons.

2.13 BACK FLOW PREVENTERS

A. Lead Free Reduced Pressure Zone Assemblies
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Watts Water Technologies, Inch (Basis of Design)
b. Conbraco Industries, Inc.
c. Honeywell Water Controls.
d. Watts Water Technologies, Inc.

2. Manufacturer: Watts

3. Model: LF909

4. Description:
The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks. The Lead Free* Reduced Pressure Zone Assembly shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall meet the requirements of ASSE Std. 1013; AWWA Std. C511-92; CSA B64.5; and UL Classified File No. EX3185. Listed by IAPMO (UPC). Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. The assembly shall be a Watts Series LF909.
5. Size: 4 inch
6. Design Flow Rate: 95 gpm
7. Materials:
a. Check Valve Bodies: FDA epoxy coated cast iron
b. Seats: Stainless Steel
c. Trim: Stainless Steel
d. Relieve Valve Body: 4" FDA epoxy coated cast iron

e. Test Cocks: Lead Free copper silicon alloy
8. Strainer Dimension: 4 inch
9. Air Gap: Factory Iron Body Air Gap model 909AG-K

B. Reduced Pressure Detector Assemblies
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
a. Conbraco Industries, Inc.
b. Honeywell Water Controls.
c. Watts Water Technologies, Inc. (Basis of Design)

2. Manufacturer: Watts

3. Model: LF957RPDA (Horizontal)

4. Description:

The Lead Free* Reduced Pressure Detector Assembly shall consist of two independent torsion spring check modules, a differential pressure relief valve located between and below the two modules, two drip tight shutoff valves, and required torsion spring check modules and relief valve shall be contained within a sleeve accessible single housing constructed from 304 (Sch 40) stainless steel pipe with groove end connections. Torsion spring checks shall have reversible elastomer discs and in operation produce drip tight closure against reverse flow caused by backpressure or backsiphonage. The Lead Free* Reduced Pressure Detector Assemblies shall comply with state codes and standards, where applicable, requiring reduced lead content. The bypass assembly consists of a meter registering either gallon or cubic measurements, a double check assembly and required test cocks. Assembly shall be Watts Series LF957RPDA

2.14 VACUUM BREAKERS

A. Pressure Vacuum Breaker Assembly:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

a. Ames Fire & Waterworks; a division of Watts Regulator Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Co. (The); Irrigation Division.
f. Watts Water Technologies, Inc.
g. Wilkins; a Zurn company.

4. Standard: ASSE 1020.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Aboveground and Underground water-service piping NPS 3 and larger to 4 shall be the following:
1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

F. Aboveground and underground Fire-Service-Main Piping NPS 4 to NPS 12 shall be the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, metal-seated gate valves with valve box.
2. Use the following for valves in vaults and aboveground:
   a. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, metal seated.
   b. Check Valves: AWWA C508, swing type.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

F. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches cover over top.
2. Under Railroad Tracks: With at least 48 inches cover over top.
3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

I. Sleeves are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

J. Mechanical sleeve seals are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

L. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

M. Facility Water piping shall also comply to the "General Requirements – Fire & Domestic Services," from Bethpage Water District. Refer to below:

The following information shall outline the general requirements of the Bethpage Water District and serve as a guideline for planning the layout, design and construction of the domestic water and fire services and may not be applicable for all situations. Specific approval must be obtained from the Water District for work different than described herein.

1. Bethpage Water District requires any section of existing main that becomes undermined to be removed and replaced following re-excavation of the disturbed supporting soil, then backfilling and compaction of the excavation area in 6-inch lifts up to existing grade. The limits of replacement shall include 8 feet into undisturbed soil on each side of the excavation.
2. Pipe shall be cement-lined ductile iron pipe. Up to 12" - Class 52, 16" - Class 51.
3. Mechanical Joint fittings shall be used on ductile-iron piping. All bends shall be strapped on both ends of the mechanical connection with ¾" steel tie rods. All mechanical joints shall use retainer glands.
4. The new section of main shall be properly chlorinated to at least 200 ppm for a minimum of 24 hours. Any residual pressure in the chlorinated piping shall be relieved prior to the 24-hour "cook" period. The main shall then be blown off to remove the chlorine solution and then pressure tested to at least 150 psi. The chlorinated solution from the main shall be used when pumping up the main with the testing equipment. No leakage will be permitted during the test.
5. Two consecutive negative bacteriological samples for each run of pipe are required, as per the Nassau County Department of Health. The district requires that the bacteriological samples be tested by H2M Labs, Inc., Melville, New York. A 3-hour wait period after final flushing is required prior to the first sample. Second sample shall be a minimum of 24 hours later.
6. H2M will be providing inspection services during the water main replacement. The owner or its general (prime) contractor will be billed for these services.
7. All fittings, bolts, threaded rods, retainer glands, etc. shall be new material. No used materials will be allowed. Retainer glands shall be used on all mechanical connections.
8. The Water District shall perform the actual shutdown. The contractor shall not operate any distribution system valves.
9. The customers to be out of service during the shutdown period must be determined and then notified at least 24 hours in advance. The water main contractor shall coordinate with the Water District on this matter.
10. Water District personnel must be present when flushing the new piping.
11. Jetting will not be permitted as a means of trench compaction.
12. Where rodding is required (between mechanical bends, tees) "L" shaped eye bolts shall be used. "Duc-Lugs" will not be permitted.
13. A pre-qualified water main contractor shall be used for the work.

Specific requirements for runs of fire line and domestic services to the building shall be as follows:

1. The Bethpage Water District, as authorized under State Sanitary Code Subpart 51, Section 31, requires that all new domestic water services be protected by a reduced pressure zone device (RPZ) and all fire sprinkler services be protected by a reduced pressure detector assembly (RPDA). As with any backflow prevention submittal, plans (11″ x 17″ preferred) must be submitted to the Bethpage Water District for review, approval and forwarding to the Nassau County Department of Health (NCDH). Please note, the NCDH requires a fee for each commercial submission. Contact the NCDH for the most current fees.
2. RPZ's, RPDA's and meters shall be installed outside in a vault located along the property fronting the public right-of-way. "Hot boxes" or the like will not be accepted.
3. Water piping shall be installed in undisturbed soil. No other utilities will occupy water trenches. Horizontal separation distances of 3'-0" shall be maintained between fire and domestic services and between water piping and other utilities or structures, unless otherwise specified.
4. Water piping shall be installed in undisturbed soil. Sharing of trenches with other utilities will not be permitted.
5. Copper and ductile-iron piping entering the building foundation walls and/or floor slabs shall be wrapped with appropriately sized Arma-Flex at the pipe-concrete interface.
6. Ductile-iron piping stubs inside the building shall be left flanged at a minimum distance of 24 inches above the floor. The end shall be blind flanged and tapped for purposes of blowing off, testing and sampling. Rodding shall be provided continuously from the flange, through the slab, to the elbow. The elbow shall be rodded back to the next fitting (or clamp).
7. On fire services utilizing a booster pump system, a pump suction control valve must be installed immediately following the fire pump.
8. The copper service shall be stubbed into the building with the full coil left protected outside the structure. The ends of the tubing shall crimped and folded.
9. Domestic and fire services larger than 2" shall be by a 3-valve cut-in only. Installation of the runs of fire line and domestic services shall start at the street stubs (installed prior to the site piping) near the property line and continued to the building.
10. A 10-foot horizontal and 18-inch minimum vertical separation from the sanitary facilities must be maintained. In cases where the water piping is above the sanitary piping and a 10-foot horizontal separation is not practical, the 18-inch minimum vertical clearance must be observed and a length of ductile iron water main shall be centered at the point of crossing. In cases where the sanitary piping is above the water piping, the sanitary piping shall be pressure rated, equivalent to the water piping.
11. No services will be tapped off water mains located within easements

N. Where there's a discrepancy with the local code and the state code, the more stringent shall apply.

3.6 JOINT CONSTRUCTION

A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Make pipe joints according to the following:
   1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

E. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.

F. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install compound-type water meters, NPS 4, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.12 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.13 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.

C. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.

D. Connect water-distribution piping to interior domestic water and fire-suppression piping.

E. Connect waste piping from concrete vault drains to sanitary sewerage system. See Division 22 Section "Facility Sanitary Sewers" for connection to sanitary-sewer piping.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.14 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.15 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.16 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

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.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

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. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

D. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain.
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.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. 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.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Formtube.

C. Color: natural.

2.6 SLEEVES

A. Cast-iron wall sleeves.
   1. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve.

2.7 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:

      a. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Piping Specialties Products.
      c. Ford Meter Box Company, Inc. (The).
      d. JCM Industries.
      e. Romac Industries, Inc.
      f. Smith-Blair, Inc.; a Sensus company.
      g. Viking Johnson.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Capitol Manufacturing Company; member of the Phoenix Forge Group.

b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 150 psig.
4. 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:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 150 psig.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating 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. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elster Perfection Corporation.

b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

C. Install underground ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. 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.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."

R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."

T. 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."

U. 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."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 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. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: 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."

E. 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.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

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 or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
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.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. 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:

      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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. 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.
   c. 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.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 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 hot-water flow 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.

3.11 CLEANING

A. Clean and disinfect 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. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

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. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

CW: Cold Water

HW: Hot Water

S: Sanitary

V: Vent

SD: Storm Drain

System	Location / Exposure	Pipe Size (Inch)	Material	Joint	Encasement
CW, HW, HWR	Outdoor Belowground	Up to 4	Ductile Iron	Mechanical	Polyethylene Encasement
	Indoor Under Building Slab	Up to 3	Ductile Iron	Mechanical	Polyethylene Encasement & Cast Iron Pipe Sleeve

	Indoor Aboveground	Up to 3	Type L Copper	Solder	None
Make Up Water	Indoor Aboveground	Up to 2	Type L Copper	Solder	None

A. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

3.13 VALVE SCHEDULE

A. Refer to section 220523, "General-Duty Valves for Plumbing Piping."

END OF SECTION 221116

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. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Wall hydrants.
7. Drain valves.
8. Water-hammer arresters.
9. Air vents.
10. Trap-seal primer valves.
11. Specialty valves.
12. Flexible connectors.

B. Related Requirements:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. FEBCO; a division of Watts Water Technologies, Inc.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

A. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

B. Lead Free Reduced Pressure Zone Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company. (Basis of Design): LF009
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to backsiphonage and/or backpressure. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. Body and shutoffs shall be constructed using Lead Free* cast copper silicon alloy materials. Lead Free* reduced pressure zone assembly shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC; ASSE Std. 1013; AWWA Std. C511; CSA B64.4. Shall be a Watts Series LF009.

2.5 THERMOSTATIC MIXING VALVE

A. Thermostatic Water Controller, Lead Free High-Low Water Mixer Unit:Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule: or comparable product by one of the following:
   a. Lawler 802

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Product Description: Master water mixing valve shall be of thermostatic type with liquid-filled thermal motor. It shall have bronze construction with replaceable corrosion-resistant components. Valve construction shall employ a sliding piston control mechanism. Sliding piston and liner shall be of stainless steel material. Valve shall come equipped with union end stop and check inlets with removable stainless steel strainers. Valve shall control

temperature from a low flow of 2 gpm up to a maximum flow rate of 103 gpm @ 80 psi. Valve shall provide protection against hot or cold supply line failure and thermostat failure.

Unit includes a dial thermometer and shut-off valve on tempered water outlet. Unit is assembled and tested with necessary fittings and nipples.

6. Finish: Chrome.
7. Tempered-Water Setting: 110°F.
8. Tempered-Water Design Flow Rate: 30 gpm.

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 that complies with AWWA C550 or that is FDA approved, epoxy coated 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: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product:

    a. Zurn Model Z1320
    b. .

2. Encased Ecolotrol "anti-siphon" automatic draining wall hydrant for flush installation. Complete with integral backflow preventer, copper casing, all bronze interior parts with ½ turn ceramic disc cartridge and combination ¾ female solder and ¾ male pipe thread inlet. Stainless steel box and hinged cover with operating key lock and "WATER" stamped on cover. (All solder connections are lead free.)

2.8 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.

2.9 WATER-HAMMER ARRESTERS

A. Water-Hammer:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product:
a. Watts Model LF 15

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following

a. MIFAB, Inc.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following

a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.
5. Standards: ASSE 1015, AWWA C510

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, and pump.

E. Install water-hammer arresters in water piping according to PDI-WH 201.

F. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

G. 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.

H. 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.

I. 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. Comply with requirements for piping specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for ground equipment in Division 26 Section "Grounding and Bonding for Electrical Systems."

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. Double-check, backflow-prevention assemblies.
3. Calibrated balancing valves.
4. Thermostatic, water mixing valves.
5. Supply-type, trap-seal primer valves.

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 inspections:

1. Test each pressure vacuum breaker, double-check, backflow-prevention assembly, according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

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 221119

SECTION 221123 - INLINE DOMESTIC-WATER 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.

1.2 SUMMARY

A. Section Includes:
   1. Horizontally mounted, in-line, close-coupled centrifugal pumps.
   2. Vertically mounted, in-line, close-coupled centrifugal pumps.

B. Related Requirements:

   1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, 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. Structural members to which pumps will be attached.
   2. Size and location of initial access modules for acoustical tile.

B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, 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.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 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 instructions for handling.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

B. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: [Cast iron], with threaded or companion-flange connections.

2.2 VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.

B. Pump Construction:

1. Casing: Radially split [cast or ductile iron], with wear rings and threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections. Include pump manufacturer's base attachment for mounting pump on concrete base.
2. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.
3. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
4. Bearings: Oil-lubricated; bronze-journal or ball type.

C. Motor: Grease-lubricated ball bearings; rigidly mounted to pump casing.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.

2.4 CONTROLS

A. Pressure Switches: Electric, adjustable for control of water-supply pump.

1. Type: Water-immersion pressure sensor, for installation in piping.
2. Enclosure: NEMA 250 Operation of Pump: On or off.
3. Transformer: Provide if required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:

1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
2. 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.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in [Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."] [Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."] Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install pressure switches in water-supply piping.

F. Install thermostats in hot-water return piping.

G. Install timers on wall in engineer's office.

H. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

    a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."
5. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. 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.

F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
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.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221313 – FACILITY SANITARY SEWERS

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 and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints and deflection fittings.
4. Cleanouts.
5. Encasement for piping.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Expansion joints and deflection fittings.
2. Backwater valves.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet (1:500) and to vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Cast-Iron, Shielded Couplings:

1. Description: ASTM C 1277 with ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.2 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. EBAA Iron, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products.

2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dresser, Inc.
b. EBAA Iron, Inc.
c. JCM Industries, Inc.
d. Smith-Blair, Inc.; a Sensus company.

2. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. EBAA Iron, Inc.

2. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Color: Black.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
   1. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

E. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
   1. Hubless cast-iron soil pipe and fittings.
   2. Expansion joints and deflection fittings.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

   1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

      a. Shielded flexiblecouplings for pipes of same or slightly different OD.

b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves post house trap.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

3.7 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
    b. Option: Test concrete gravity sewer piping according to ASTM C 924 (ASTM C 924M).

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 221313

SECTION 221316 - SANITARY 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. Division 22 Section "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Division 22 Section "Sanitary Sewerage Pumps" for sewage pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Waste, Force-Main Piping: 100 psig.

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.

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. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 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. Shielded, Nonpressure 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; a division of MCP Industries, Inc.

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.

4. 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) JCM Industries, Inc.
5) Romac Industries, Inc.
6) Smith-Blair, Inc.; a Sensus company.
7) The Ford Meter Box Company, Inc.
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: [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) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at.

3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. 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) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg .
4) End Connections: Male threaded.
5) Lining: Inert and noncorrosive, propylene.

2.4 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: tube.

D. Color: natural.

2.5 SLEEVE

A. Cast-iron wall sleeves.
   1. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "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 Division 22 Section "Vibration and Seismic 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. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building and Horizontal Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. 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.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install force mains at elevations indicated.

Q. Plumbing Specialties:
1. 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 Division 22 Section "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. 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."

T. 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."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. 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.

B. 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.

C. 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.

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, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
   a. .

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

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 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. 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 and larger.

D. Connect force-main piping to the following:
1. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 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 Division 22 Section "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. 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. 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 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 above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for fourPIPING 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.

3.11 PIPING SCHEDULE

System	Location / Exposure	Pipe Size (Inch)	Material	Joint	Encasement

S, and V	Outdoor Belowground	Up to 6	Cast Iron	Hubless Piping Coupling Joint	Polyethylene Film Encasement
S, and V	Indoor Under Building Slab	Up to 6	Cast Iron	Hubless Piping Coupling Joint l	Polyethylene Film Encasement & Cast Iron Pipe Sleeve
S (including Force Sanitary) and, V	Indoor Aboveground	Up to 6	Cast Iron	Hubless Piping Coupling Joint l	None

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

END OF SECTION 221316

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. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.

B. Related Requirements:

1. Division 22 Section "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Division 33 Section "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. 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."

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. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Drainage 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Deck Plate Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Stainless steel.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Cast-iron plug.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

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: cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, stainless-steel cover plate with screw.
8. Wall Access: Round stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Zurn model FD-2320-R5

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Chrome Plated Strainer Assembly
6. ½" Trap Primer Connection
7. 6" Diameter Nickel Head Assembly
8. Vandal Proof
9. No Hub Connection – Refer to plumbing fixture schedule for size. Provide minimum 3"Ø connection.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ayrlett, LLC.
b. Durgo, Inc.
c. Oatey.
d. ProSet Systems Inc.
e. RectorSeal.
f. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.4 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; Elmdor/Stoneman Div.
      b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inchesfrom pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

   1. Open-Top Vent Cap: Without cap.
   2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
   3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Expansion Joints:

   1. Standard: ASME A112.21.2M.
   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.

2.7 FLASHING MATERIALS

A. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install fixture air-admittance valves on fixture drain piping.

F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. 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.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.

D. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.

F. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

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."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. 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, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. 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.

3.5 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.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE 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. Division 22 Section "Sump Pumps" for storm drainage pumps.
2. Division 33 Section "Storm Utility Drainage Piping" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage 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.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage 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 equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 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. Shielded, Nonpressure 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; a division of MCP Industries, Inc.

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.

4. 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-Blair, Inc.; a Sensus company.
8) Viking Johnson; c/o Mueller Co.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Ductile 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) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. 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) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel-backing washers.

4. Dielectric Nipples:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Elster Perfection.
      2) Grinnell Mechanical Products.
      3) Matco-Norca, Inc.
      4) Precision Plumbing Products, Inc.
      5) Victaulic Company.

   b. Description:

      1) Electroplated steel nipple complying with ASTM F 1545.
      2) Pressure Rating: 300 psig at 225 deg F.
      3) End Connections: Male threaded or grooved.
      4) Lining: Inert and noncorrosive, propylene.

2.4 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.

C. Form: tube.

D. Color: natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "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 from 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 Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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 storm 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. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

N. 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.

O. Plumbing Specialties:

1. ."
2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Storm Drainage Piping Specialties."
3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. 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."

R. 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."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. 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.

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, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 6: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "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.
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.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. 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. Comply with requirements for cleanouts and drains specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "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.
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 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. 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.

3.10 CLEANING

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.

3.11 PIPING SCHEDULE

System	Location / Exposure	Pipe Size (Inch)	Material	Joint	Encasement
Storm Drain	Outdoor Belowground	Up to 6	Cast Iron	Hubless Piping Coupling Joint	Polyethylene Film Encasement
	Indoor Under Building Slab	Up to 6	Cast Iron	Hubless Piping Coupling Joint	Polyethylene Encasement & Cast Iron Pipe Sleeve
	Indoor Aboveground	Up to 6	Cast Iron	Hubless Piping Coupling Joint	None

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE 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. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Through-penetration firestop assemblies.
5. Flashing materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Combination Main Roof and Overflow Drain with Low Silhouette Domes and Double Top-Set Deck Plate:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Zurn model Z164

   2. Standard: ASME A112.6.4, for general-purpose roof drains.
   3. Body Material: Cast iron.
   4. Description: 12 inch diameter roof drain and overflow drain, Dura-Coated cast iron bodies with combination membrane flashing clamp/gravel guards, double Top-Set deck plate, and low silhouette cast iron domes.
   5. D.C.C.I Body with aluminum dome (6-9/16 inch dome height)
   6. Acid Resistant Epoxy Coated Finish

7. Stainless Steel Mesh Screen Over Dome
8. Vandal Proof Secured Top

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Stainless Steel Downspout Cover:

1. Manufacturer: Watts

2. Model: RD-950
3. Size: Inlet size to match with storm drain piping. Refer to plan.
4. Vandal Proof.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.

5. Closure Plug: brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

   a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. 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.
6. 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.
7. Special Coating: Corrosion resistant on interior of fittings.

2.5 FLASHING MATERIALS

A. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall. Provide splash blocks below downspout boots.

D. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

G. Install test tees in vertical conductors and near floor.

H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

I. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. 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 the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 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.

END OF SECTION 221423

SECTION 221429 - 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.

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 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.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Simplex Sump Pump:
   1. Manufacturers:
      a. Zoeller Company Model Z137.
      b. Liberty ELV250

   2. Single Phase Motor – Pump motor shall be hermetically sealed, submersible type operating in a high quality dielectric oil for cooling the windings and for lubrication of the motor bearings and ceramic-carbon shaft seal. Single phase motor shall have internal automatic resetting, thermal overload protection. Construction shall be of cast iron with 100% baked-on powder coated epoxy finish for corrosion resistance and longer casting durability. All fasteners and external metal parts shall be of stainless steel. Impeller shall be of vortex non-clog design.
      a. 137 cast iron series pump shall have ½ HP split phase motor with current sensing, starting relay enclosed in switch housing.
   3. Control Panel shall be furnished for the automatic pump. The panel shall have a NEMA 4X enclosure, pump run indicator light, high water alarm, selector switches, float switches, and UL label. Panel will be sized for 115 Volt, 1 Phase, 60 Cycles, ½ HP pump.
   4. 30-0152, 2 inch cast iron full flow check valve with 2 inch female N.P.T. Rated at 50 PSI (115 feet TDH) at 130° F. Neoprene polyester reinforced flapper with cast iron and brass backing plates and stainless steel fastener.
   5. 10-0126 (115V/1Ph) High level Alarm complete with NEMA 4X enclosure, alarm bell, Alarm light, Silence switch, and sensor float switch with 15’ cord. Entire unit is UL Listed and CSA Certified.
   6. Float Switch Tree (#10-1886); 115.1.60, 5 AMPS.
   7. Pumps shall be installed in the elevator concrete pit. Pit shall be provided by GC. PC to coordinate.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Division 31 Section "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

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.

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. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system 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.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

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.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 223500 – DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Indirect-fired, storage, domestic-water heaters.
2. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product: rated capacities, operating characteristics, electrical characteristic, and furnished specialties and accessories

B. Shop Drawings:
1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades. Also indicate the following:

1. Tube removal space, both vertical and/or horizontal as applicable.
2. Structural members to which heat exchangers will be attached.

B. Seismic Qualification Data: Certificates, for domestic-water heat exchangers, water heaters, 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.

C. Product Certificates: For each type of from manufacturer.

1. Domestic-Water, Heat-Exchanger Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
2. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic-water heat exchangers and heaters to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchangers that fail in materials or workmanship within specified warranty period.

B. Warranty Period:
   1. HEAT EXCHANGER(S) shall carry a non-prorated (5) year warranty.
   2. STORAGE TANK shall carry a non-prorated warranty by one of the following:
   3. Ten (10) year limited warranty on carbon steel tank with double glass lining.
   4. Fifteen (15) year limited warranty on duplex stainless steel tank.
   5. ALL OTHER COMPONENTS shall carry a non-prorated one (1) year warranty.

C. Special Warranty: Manufacturer agrees to repair or replace components of domestic-water heat exchangers and heaters that fail in materials or workmanship within specified warranty period.

D. Failures include, but are not limited to, the following:

a. Structural failures, including domestic-water heat exchanger, water heater, storage tank, and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2.1 PRODUCTS

2.2 PERFORMANCE REQUIREMENTS

2.3 Compliance with ASHRAE/IES 90.1 is required by LEED 2009, LEED v4, IgCC, ASHRAE 189.1, and Green Globes and may be required, even when they do not apply.

A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61and NSF 372.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2.4 For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

2.5 INDIRECT-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Manufacturers

1. Diversified Heat Transfer Inc. (DHT)
2. Heat - Flo

B. Description: Factory-packaged, hot-water storage tank with heat-exchanger coil, circulator, controls, and specialties for heating domestic water with heating hot water in coil.

C. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.

D. Storage-Tank Construction: ASME-code Carbon Steel with 150-psig working-pressure rating. Include nozzle and head for heat-exchanger tube coil.
1. Configuration: Vertical.

2. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.
   a. NPS 3 (DN 80) Threaded ends according to ASME B1.20.1.

3. Lining: Carbon Steel material tanks must have double glass lining complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
4. Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.
5. Anode Rods: Factory installed, magnesium.
6. Dispersion Tubes: installed on both cold and hot water inlet to prevent mixing of hot and cold water inside the tank.

E. Brazed-Plate, Heat-Exchanger: Assembly of heat-exchanger plates, permanently brazed together.

1. Working-Pressure Rating: Heat-Exchanger plates, permanently brazed together shall be rated for 150 psig minimum at 250°F.
2. Plate Construction: Double wall.
3. Plate Material: 316L Stainless steel plates.
4. Plate Thickness: Not less than 0.024 inch (0.6 mm) combined.
5. Brazing Filler Metal: Copper.
6. Heat Exchanger Connections: 2 inches (DN 50) Victaulic.
7. AHRI 400: Use heat exchanger certified by AHRI Liquid to Liquid Brazed and Fusion Bonded Plate Heat Exchangers (LLBF) certification program, based on AHRI Standard 400.
8. KIWA certification: Use KIWA certified double wall Brazed-plate heat exchanger.

F. Temperature Control: Include adjustable temperature solid-state control module with touchscreen user interface, mounted externally on unit skid. Control panel temperature set point range shall be from minimum 35°F to maximum 180°F. Unit shall include modulating Electronic Control Valve(s) to maintain hot water supply temperature within +/-4 deg F variation from set point when operated under normal load conditions with maximum load variation up to 25% of heating capacity.

G. Safety Control: Automatic, high-temperature-limit cutoff device or system. Include sound alarm functionality in the safety controls. Red color error message display on screen when hot water temperature reaches alarm setting and alarm shall start sounding. In the next step, controller shall interrupt power supply to the control valve causing it to close. When unit goes back to normal operating temperature conditions, display screen status changes back to green color and the power to control valve shall restore. Also include manual switch on front of the control panel to silence the alarm.

H. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and

include pressure setting less than working-pressure rating of heat exchanger. Select relief valve with sensing element that extends into storage tank.

I. Gauges: Factory-mounted thermometer and pressure gauge.

J. Circulating Pump: UL/CUL listed, lead-free bronze and/or stainless steel material construction, in-line pump(s). Include mechanical seals, 150-psig maximum working-pressure rating, and 230 deg F continuous-water-temperature rating.

1. Pump Control: Constant speed pump to circulate water through each heat exchanger to maintain water temperature in tank.

K. Support: Factory mounted on skids.

1. Control Panel shall be provided with the following associated features:
   a. Factory mounted on the skid package. Provide manual disconnect switch for power supply to control panel and refer to electrical drawings/specifications as well as codes for details.
   b. Touchscreen HMI user interface display with easy adjustable set points. Backup LCD display on feedforward PID controller installed inside the control panel enclosure.
   c. Control Panel shall have two level password protections for settings adjustment.
   d. Process indication displayed on the colored touchscreen display on home screen with user configurable through plain English menus.
   e. Solid-state control module shall be provided with a field programmable digital electronic HMI and PID controller allowing the user to set operating and temperature limits on the display screen.
   f. Solid –state control module shall be supplied with dry contact closure outputs to indicate to building management system (BMS) the occurrence of high temperature alarm condition.
   g. Control module shall be supplied with an on-off switch and shall be mounted in a NEMA 4X panel; all limits shall be 24 VAC.

L. Building/Energy Management System Interface: The control panel either shall or shall not be capable of remote communications with the building management system to:

1. Turn the heater on or off through dry contact.
2. Remotely set the temperature of the heater using 4-20mA input signal.
3. Remotely monitor the operating temperature.
4. Remotely monitor high and low temperature alarm.
5. Remotely monitor inlet and outlet temperature sensor status.
6. Remotely monitor control valve opening percentage.
7. Compatibility with Modbus and BACnet /IP standard. For Interface with BACnet MS/TP, LonWorks, Metasys N2 and Modbus RTU protocols; an external Diversified Heat Transfer supplied built-in translation communications gateway shall be utilized.

M. Required Connections: Domestic cold water in; domestic hot water out; heating hot-water supply in; heating hot water out.

2.6 ACCESSORIES

A. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IES 90.1
B. Heat-Trap Fittings: ASHRAE 90.2.
C. Combination Temperature- and Pressure-Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than heat-exchanger working-pressure rating. Select relief valves with sensing element that extends into storage tank.
D. Pressure-Relief Valves: ASME rated and stamped. Include pressure setting less than heat-exchanger working pressure rating.
E. Vacuum-Relief Valves: ANSI Z21.22/CSA 4.4.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heat exchangers and domestic-water heaters specified to ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heat exchangers and domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heat exchangers and domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

3.1 EXECUTION

3.2 INSTALLATION OF DOMESTIC-WATER HEAT EXCHANGERS AND DOMESTIC-WATER HEATERS

A. Domestic-Water Heat Exchangers and Domestic-Water Heaters Mounting: Install domestic-water heat exchangers and domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "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.
5. Anchor heat exchangers and heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic cold-water supply piping to domestic-water heat exchangers and domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Install shutoff valves on heating hot-water piping to domestic-water heat exchangers and domestic-water heaters. Comply with requirements for shutoff valves specified in Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
3. Install shutoff valves on steam and condensate piping to domestic-water heat exchangers and domestic-water heaters. Comply with requirements for shutoff valves specified in Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

C. Install domestic-water heat exchangers and domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install temperature- and pressure-relief valves in top portion of domestic-water storage tank shells. Use relief valves with sensing elements that extend into shells. Extend relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature- and pressure-relief valves in water piping for domestic-water heat exchangers and domestic-water heaters without storage. Extend relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install domestic-water heat exchangers and domestic-water heaters drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in domestic-water piping for heat exchangers and heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on each domestic-water heater inlet and outlet piping, and install thermometer on each heater heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 220519 "Meters and Gauges for Plumbing Piping."

H. Install pressure gauges on domestic-water heat exchanger and domestic-water heater heating-fluid piping. Comply with requirements for pressure gauges specified in Section 220519 "Meters and Gauges for Plumbing Piping."

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for heating hot-water piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

C. Comply with requirements for steam and condensate piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

D. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Where installing piping adjacent to domestic-water heat exchangers and heaters, allow space for service and maintenance. Arrange piping for easy removal of heat exchangers and heaters.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. 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 operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Domestic-water heat exchangers and domestic-water heaters will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic-water indirect-fired domestic-water heaters.

END OF SECTION 223500

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. PVC pipe and fittings.
   2. Cleanouts.
   3. Manholes.

1.2 REFERENCES

A. Nassau County Department of Public Works – Standard Details for the Construction of Sanitary Sewers.

B. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Product Data: For the following:

   1. Pipe and fittings.
   2. Non-pressure and pressure couplings
   3. Expansion joints and deflection fittings.
   4. Backwater valves.
   5. Cleanouts.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Pressure Piping:

   1. Pipe: AWWA C900, DR-18 PVC pipe with bell-and-spigot ends for gasketed joints.

2.2 CLEANOUTS

A. Furnish materials in accordance with Nassau County Department of Public Works standards.

2.3 MANHOLES

A. Furnish materials in accordance with Nassau County Department of Public Works standards.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 23 16 Excavating and Section 31 23 17 Trenching.

3.2 EXAMINATION

A. Verify trench cut is trimmed, compacted and ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.3 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.4 BEDDING

A. Excavate pipe trench in accordance with Section 31 23 17 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.5 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with Nassau County Department of Public Works standards.

3.6 INSTALLATION - MANHOLES

A. Install Work in accordance with Nassau County Department of Public Works standards.

3.2 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Manholes: Perform hydraulic test according to ASTM C969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.3 CLEANING

A. Clean dirt and superfluous material from interior of piping.

3.4 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
   1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
   2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION 221313

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 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.

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 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.

2.3 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.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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 (Not Applicable)

END OF SECTION 230513

SECTION 230514 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 separately enclosed, pre-assembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections:
1. Section 230500, Common Work Results for HVAC
2. Section 230513 – Common Motor Requirements for HVAC Equipment.
3. Section 230923, Instrumentation and Controls for HVAC
4. Division 26, Electrical

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

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. VFD: Variable-frequency drive.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each VFD 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 VFD and installed devices.
g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs. Show VFD 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.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For each VFD, from manufacturer.

D. Source quality-control reports.

E. Field quality-control reports.

F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

G. 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.

H. Harmonic Mitigation test results.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFDs 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 thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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 two 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.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or 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: The engineer shall ensure the drive application meets the recommendations contained in IEEE Standard 519. The building primary service entrance shall be considered the Point of Common Coupling (PCC) for establishing current harmonic limits. Total harmonic voltage distortion (THD) shall not exceed 5% at any point in the building distribution system, except in separately derived systems dedicated to the harmonic producing equipment.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store equipment in a space that is permanently enclosed and air conditioned.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without de-rating, 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.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical systems without Construction Manager's and Owner's written permission.
4. Comply with NFPA 70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

1.11 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.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.
2. Honeywell.
3. Yaskawa Electric America, Inc; Drives Division.

B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: variable torque.

D. VFD 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. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. 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.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.

4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 42 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: Less than 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 1.8 times the base load current for three seconds.
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.

H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.
2. Signal: Pneumatic.

J. 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.

K. Self-Protection and Reliability Features:

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. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD 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.

L. 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.

M. 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.

N. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
2. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. 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.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. 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.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).

4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

   a. A minimum of two programmable analog inputs: Operator-selectable "x"- to "y"-mA dc.
   b. A minimum of six multifunction programmable digital inputs.

2. Output Signal Interface: A minimum of one programmable analog output signal(s) (operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:

   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).

3. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

F. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.

1. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.

G. All control wiring shall be shielded, single twisted pair wire and installed in separate conduit from power wiring. All individual wires shall be labeled on both ends.

H. A complete as-built wiring diagram shall be permanently affixed to the inside of the drive control section at the end of commissioning with all field setpoints identified.

I. The drives shall be capable of accepting external, permissive contacts such as a freezestat, static pressure safety, damper end switch, or smoke purge mode. One set of external contacts

shall de-energize the motor whether the drive is in automatic, manual drive, or bypass mode. All drives shall be capable of issuing commands to all available digital output contacts.

2.3 LINE CONDITIONING AND FILTERING

A. All VFD's using 6 pulse conversion technology shall be specified with a 5% DC choke and a 3% AC line reactor.

2.4 BYPASS SYSTEMS

A. Bypass Mode: Manual operation only; requires local operator selection at VFD. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.

B. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller**;** with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA -rated contactor.
2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

C. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
    b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 50 VA.

6. Overload Relays: NEMA ICS 2.

    a. Solid-State Overload Relays:

1) Switch or dial selectable for motor-running overload protection.
2) Sensors in each phase.
3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
5) Analog communication module.

b. External overload reset push button.

D. The VFD / bypass shall allow the BAS to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.

E. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

2.5 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Outdoor enclosure sizes must be coordinated enclosure manufacturer to meet the air flow requirements of selected manufacturer.

2.6 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy duty.

a. Push Buttons: Recessed types; momentary.
b. Pilot Lights: LED types; red.
c. Selector Switches: Rotary type.

B. NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

E. Spare control-wiring terminal blocks; unwired.

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.

1. Test each VFD while connected to its specified motor.
2. Verification of Performance: Rate VFDs according to operation of functions and features specified.

B. VFDs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

A. Prepare a harmonic analysis study and report complying with IEEE 519 and NETA Acceptance Testing Specification.

3.3 INSTALLATION

A. VFDs shall be furnished by this Division and installed by Division 26.

B. Engineering, programming, and low voltage control wiring shall be by this Division.

3.4 IDENTIFICATION

A. Identify VFDs, components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. 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. 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.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
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 VFD. 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 VFD 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.

D. VFDs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

A. 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.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

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 VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs. Provide two sets of VFD operation manuals for use at the training session and then provide to the Owner after completion of the session.

END OF SECTION 230514

SECTION 230517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 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; an EnPro Industries company (LINK-SEAL).
4. Metraflex Company (The).
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: Reinforced Nylon Polymer.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 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.

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-inch 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 1/4-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 Section 079200 "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 Section 078413 "Penetration Firestopping."

3.2 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.

3.3 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.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

   a. Galvanized-steel-pipe sleeves with sleeve-seal system.

      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. Galvanized-steel-pipe sleeves with sleeve-seal system.

      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. Galvanized-steel-pipe sleeves.

5. Interior Partitions:

   a. Galvanized-steel-pipe sleeves.

END OF SECTION 230517

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. Liquid-in-glass thermometers.
2. Duct-thermometer mounting brackets.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test plugs.
7. Test-plug kits.

B. Related Requirements:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.
2. Section 230923 “Instrumentation and Control for HVAC”

1.3 SUBMITTALS

A. Product Data: For each type of product. Include product application schedule.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

C. Product Certificates: For each type of meter and gage.

D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Trerice, H.O. Co
    b. Weiss Instruments, Inc
    c. Weksler Glass Thermometer Corp.
    d. Winters Instruments – U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum and length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Trerice, H.O. Co
    b. Weiss Instruments, Inc
    c. Weksler Glass Thermometer Corp.
    d. Winters Instruments – U.S.

2. Standard: ASME B40.200.
3. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
4. Material for Use with Copper Tubing: Brass.
5. Material for Use with Steel Piping: Stainless steel.
6. Type: Stepped shank unless straight or tapered shank is indicated.
7. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
8. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
9. Bore: Diameter required to match thermometer bulb or stem.
10. Insertion Length: Length required to match thermometer bulb or stem.
11. Lagging Extension: Include on thermowells for insulated piping and tubing.

12. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 DIAL-TYPE 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:

a. Trerice, H.O. Co
b. Weiss Instruments, Inc
c. Weksler Glass Thermometer Corp.
d. Winters Instruments – U.S.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); stainless steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Siphons: Loop-shaped section of brass or stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trerice, H.O. Co
2. Weiss Instruments, Inc
3. Weksler Glass Thermometer Corp.
4. Winters Instruments – U.S.

B. Description: Test-station fitting made for insertion in piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trerice, H.O. Co
2. Weiss Instruments, Inc
3. Weksler Glass Thermometer Corp.
4. Winters Instruments – U.S.

B. 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.

C. 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.

D. 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.

E. 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.

F. Carrying Case: Metal or plastic, with formed instrument padding.

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 syphon fitting in piping for each pressure gage for fluids.

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.

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 chiller.
4. Inlet and outlet of each hydronic coil in air-handling 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.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for 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 SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

C. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F and 0 to plus 115 deg C.

D. Scale Range for Steam and Steam-Condensate Piping: 30 to 240 deg F and 0 to plus 115 deg C.

E. Scale Range for Air Ducts: Minus 40 to plus 110 deg F and minus 40 to plus 45 deg C.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 160 psi.

B. Scale Range for Condenser-Water Piping: 0 to 160 psi.

C. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.

D. Scale Range for Steam Piping: 0 to 30 psi.

END OF SECTION 230519

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.

1.2 SUMMARY

A. Section Includes:

1. Ball valves.
2. Iron, single-flange butterfly valves.
3. High-performance butterfly valves.
4. Check valves.
5. Gate valves.
6. Chainwheels.

B. Related Sections:

1. Division 23 Section “Hydronic Piping Specialties” for hydronic specialty valves including calibrated-orifice, balancing valves.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

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.

B. Valve Schedule: Indicate system, size, service, and model number for each valve.

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.
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 for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 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.

E. 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.

F. 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.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BALL VALVES

A. 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.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
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.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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. Crane Co.; Crane Valve Group.
    d. DeZurik Water Controls.
    e. Flo Fab Inc.
    f. Hammond Valve.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Red-White Valve Corporation.
    j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig.
    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: Stainless steel.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Jamesbury; a subsidiary of Metso Automation.
    i. Milwaukee Valve Company.
    j. NIBCO INC.
    k. Process Development & Control, Inc.
    l. Tyco Valves & Controls; a unit of Tyco Flow Control.
    m. Xomox Corporation.

2. Description:

    a. Standard: MSS SP-68.
    b. CWP Rating: 720 psig at 100 deg F.
    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: Carbon steel.
h. Service: Bidirectional.

2.5 CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, 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.

C. Class 125, Iron Swing Check Valves with 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; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
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. Sure Flow Equipment Inc.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

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: Bronze.
h. Gasket: Asbestos free.

D. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. 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 126, gray iron.
e. Style: Compact wafer.
f. Seat: Bronze.

2.6 GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, NRS, Iron Gate Valves:

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. Crane Co.; Crane Valve Group; Stockham Division.
d. Flo Fab Inc.
e. Hammond Valve.
f. Kitz Corporation.
g. Legend Valve.

h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, 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 Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

2.7 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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 valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
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 valves NPS 4 and larger and more than 96 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 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. General applications:
1. Balancing: Calibrated-orifice, balancing valves (refer to Division 23 Section "Hydronic Piping Specialties").
2. Manual Drains: Ball valves.
3. Dead-End: Single-flange butterfly valves
4. Building-Level Hydronic System Isolation: High performance butterfly 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. Install shutoff valves at each branch connection to supply mains and at supply connection to each piece of equipment.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. 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 VALVE SCHEDULE

System	Pipe Diameter (in)	Shutoff Service	Check Valve Service
Heating Hot Water	2 and below	Ball	45 deg Swing Check
	2-1/2 and above	Butterfly	Center-Guided
Chilled Water	2 and below	Ball	45 deg Swing Check
	2-1/2 and above	Butterfly	Center-Guided
Condenser Water	2 and below	Ball	45 deg Swing Check
	2-1/2 and above	Butterfly	Center-Guided
Low Pressure Steam	2 and below	Gate	Lift Check
	2-1/2 and above		Swing Check
Low Pressure Steam Condensate	2 and below	Gate	Lift Check
	2-1/2 and above		Swing Check

END OF SECTION 230523

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.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" 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 and obtain approval from authorities having jurisdiction.

1.5 ACTION 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. Pipe stands.
4. 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.

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. Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. 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.

B. 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.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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, 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.

2.6 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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.

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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. 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.

F. 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 Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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 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.

B. 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 fiberglass pipe hangers and fiberglass strut systems 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 non-insulated 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 non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, 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-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.
    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 in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS 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.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.
18. Vibration isolation equipment bases.
19. Restrained isolation roof-curb rails.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. 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.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic and Wind-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

E. Qualification Data: For testing agency.

F. Welding certificates.

G. test data performed by an independent agency.

H. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.
d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.
f. Korfund.
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
k. Vibration Mountings & Controls, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth, Ribbed, or Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient or elastomeric

a. Surface Pattern: Smooth, Ribbed, or Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.
d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.
f. Korfund
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
k. Vibration Management Corp.
l. Vibration Mountings & Controls, Inc.

B. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.
d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.
f. Korfund.
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
2. Vibration Management Corp.
3. Vibration Mountings & Controls, Inc.

B. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.

1. Mason Industries
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.6 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.

1. Mason Industries
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside 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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.9 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.10 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.11 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.12 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.13 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 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. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 AIR-SPRING ISOLATOR INSTALLATION

A. Independent Isolator Installation:

1. Install tank valve into each air isolator.

2. Inflate each isolator to heigh and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered constant air supply.
3. Inflate isolators to height and or pressure specified on Drawings.

3.8 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.

END OF SECTION 230548

SECTION 230553 - 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. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 be included in maintenance manuals.

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. Letter Color: White.
3. Background Color: Black.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. 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-quarters 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.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and 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) and 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: White.

C. Background Color: Red.

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-quarters 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 according to ASME A13.1.

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; also include 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: Size letters according to ASME A13.1 for piping. At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

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: Refer to section 3.5.

C. Background Color: Refer to section 3.5.

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-quarters 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; also include 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.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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. Description: 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: Red background with white 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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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 and on both sides of 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.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background
2. Heating Water Piping: White letters on a safety-green background.
3. Refrigerant Piping: White letters on a safety-purple background.

3.5 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.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. All services: 2 inches, round.

2. Valve-Tag Colors:

a. All services: Natural

3. Letter Color:

a. All services: Black

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Primary-secondary hydronic systems.
3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Chillers.
    c. Heat-transfer coils.
5. Testing, adjusting, and balancing existing systems and equipment.
6. Sound tests.
7. Vibration tests.
8. Duct leakage tests.
9. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site with the Architect, Construction Manager, Commissioning Authority, and Engineer after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 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. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. 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.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: The balancing agency shall be an independent contractor certified by NEBB, or TABB and shall have no affiliation with a mechanical contracting or sheet metal company and shall have at least one Professional Engineer registered in the State in which the services are to be performed.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB, or, TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB, or, TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

3.2 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 installed systems for 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 applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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 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.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, 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 have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, 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.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in the correct direction.
f. Variable-frequency controllers' startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. The water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves function per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete, and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.4 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" or ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 "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.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

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 Section 233113 "Metal Ducts."

3.6 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. 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.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. 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 occurs. 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.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point 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.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust the system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.10 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. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.

e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

   a. Measure differential pressure and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

   a. Measure total water flow.

      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

   b. Measure pump TDH as follows:

      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gage heights.

4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

a. Measure differential pressure, and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

13. Verify that memory stops have been set.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gage heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.

2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.12 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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.15 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

B. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feed water flow.
3. Measure and record leaving-steam pressure and temperature.
4. Record relief valve pressure setting.

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 for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

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.
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. 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.

3.17 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at **5** locations as designated by the Architect.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:

   a. Location.
   b. System tested.
   c. dBA reading.
   d. Sound pressure level in each octave band with equipment on and off.

2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.18 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.19 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.

7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.20 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0% to +5%.
2. Air Outlets and Inlets: 0% to +5%.
3. Heating-Water Flow Rate: 0% to +5%.
4. Cooling-Water Flow Rate: 0% to +5%.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.21 PROGRESS 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 biweekly 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.

3.22 FINAL REPORT

A. General: Prepare 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.
3. Certify validity and accuracy of field data.

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.

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 specialist.
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 airflow 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. Airflow 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. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. 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.
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.

I. 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 airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. 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. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. 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. Airflow 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.

L. 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.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.23 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. The Construction Manager 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.

C. 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."

D. 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.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall 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.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

F. Prepare test and inspection reports.

3.24 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 230593

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. Flexible Elastomeric
    b. Mineral-Fiber Blanket Insulation
    c. Mineral-Fiber Board Insulation
    d. Mineral-Fiber Preformed Pipe Insulation
    e. Mineral-Fiber Pipe and Tank Insulation
2. Fire-Rated Insulation Materials
3. Adhesives
4. Mastics
5. Lagging Adhesives
6. Sealants
7. Factory-Applied Jackets
8. Field-Applied Fabric-Reinforcing Mesh
9. Field-Applied Cloths
10. Field-Applied Jackets
11. Tapes
12. Securements
13. Corner Angles

B. Related Sections:
1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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, dampers, flanges, valves, and specialties and flanges for each type of insulation.

5. Detail removable insulation at piping specialties and equipment connections.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. 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.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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 the manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with Installer for insulation application. Before preparing Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. 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.

2.1 INSULATION MATERIALS

A. General

1. Comply with requirements in insulation schedule articles for where insulating materials shall be applied.
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. 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.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

C. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

D. 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. Factory-applied jacket requirements are specified in the "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.

f. Owens Corning; Fiberglas 700 Series.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc. ; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in the "Factory-Applied Jackets" Article.

F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory applied ASJ 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. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, 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. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 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. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.7 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. (271 g/sq. m).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABI, Ideal Tape Division; 491 AWF FSK.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    c. Compac Corporation; 110 and 111.
    d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal 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.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.

3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. 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. 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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. 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 ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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.

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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct 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 (100 mm) 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.

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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. 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 (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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 (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: 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 (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 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, 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 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. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.
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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION ON DUCT SYSTEMS

A. 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 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. 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 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
   b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).

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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION ON PIPING SYSTEMS

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 (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, 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 (25 mm), 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.
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.

3.9 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) 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.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.10 FINISHES

A. 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.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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 one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. 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.

3. 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 one 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.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 DUCT INSULATION SCHEDULE

A. General:
1. Plenums and Ducts Requiring Insulation:
   a. Indoor, concealed supply and outdoor air.
   b. Indoor, exposed supply and outdoor air.
   c. Indoor, concealed return located in unconditioned space.
   d. Indoor, exposed return located in unconditioned space.
   e. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
   f. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   g. Outdoor, concealed supply and return.

h. Outdoor, exposed supply and return.

2. Items Not Insulated:
   a. Fibrous-glass ducts.
   b. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   c. Factory-insulated flexible ducts.
   d. Factory-insulated plenums and casings.
   e. Flexible connectors.
   f. Vibration-control devices.
   g. Factory-insulated access panels and doors.
3. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Duct Insulation Schedule:

Duct System	**Location**	**Insulation**	**Jacket**
Supply Return Outside Air (conditioned)	Outdoors	Mineral-Fiber Board: 3" thick 3-lb/cu. ft.	Aluminum: Smooth 0.016" thick
Supply Return Outside Air (all) DX Condenser Air	Indoors: Mechanical rooms, shafts, crawlspaces, trenches	Mineral-Fiber Board: 2" thick 3-lb/cu. ft.	None
Return	Indoors: In ceiling void of room served	None	None
Supply Return Outside Air (all) DX Condenser Air	Indoors: All other areas not listed above	Mineral-Fiber Blanket: 2" thick 0.75-lb/cu. ft.	None

3.13 PIPING INSULATION SCHEDULE

A. General:
1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.
2. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   a. Drainage piping located in crawl spaces.
   b. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Pipe, Valve, and Fitting Insulation Material Schedule:

Pipe System	**Insulation Material**	**Vapor Barrier Locations**
Refrigerant	Preformed Flexible Elastomeric Insulation	-
Cold Condensate Drain	Preformed Flexible Elastomeric Insulation	-
Chilled Water	Mineral Fiber, Preformed Pipe Insulation	All Installations
Heating Hot Water	Mineral Fiber, Preformed Pipe Insulation	Outdoors

C. Pipe, Valve, and Fitting Insulation Thickness Schedule:

Pipe System	Insulation Thickness
Refrigerant	1.5″
Cold Condensate Drain	0.5″
Chilled Water	2.0″
Heating Hot Water, ≤ 1.5" diameter	1.5″
Heating Hot Water, > 1.5" diameter	2.0″

1. The above table is based on insulation having a conductivity (k) not exceeding 0.27 Btu per inch/h · ft2 °F.
2. For insulation with a thermal conductivity not equal to 0.27 Btu · inch/h · ft2 · °F at a mean temperature of 75°F, the minimum required pipe thickness is adjusted using the following equation;

   T = r [(1+tlr)K/k-1]
   where:
   T = Adjusted insulation thickness (in).
   r = Actual pipe radius (in).
   t = Insulation thickness from applicable cell in table (in).
   K = New thermal conductivity at 75°F (Btu · in/hr · ft2 · °F).
   k = 0.27 Btu · in/hr · ft2 · °F

D. Pipe, Valve, and Fitting Insulation Field-Applied Jacketing Schedule:

Pipe System Location	Jacket
Outdoors	Aluminum
Indoors, inaccessible Portions of Shafts	None
Indoors, exposed	PVC

3.14 EQUIPMENT INSULATION SCHEDULE

A. General:
   1. Insulation materials and thicknesses are identified below.
   2. Insulate indoor and outdoor equipment that is not factory insulated.

B. Equipment Insulation Schedule:

Equipment	Insulation	Thickness	Jacket
Pumps	Mineral Fiber, Pipe and Tank Insulation	2″	PVC
Expansion tanks	Mineral Fiber, Pipe and Tank Insulation	2″	PVC
Air separators	Mineral Fiber, Pipe and Tank Insulation	2″	PVC

END OF SECTION 230713

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including:

1. Direct digital control system components.
2. Temperature transmitters.
3. Thermistors.
4. Static pressure transmitters.
5. Protective thermostats and detectors.
6. Relative humidity transmitters.
7. Humidity and temperature transmitters - outdoor air.
8. Thermowells.
9. Resistance temperature detectors.
10. Differential pressure transmitters.
11. Airflow-measuring station.
12. Differential pressure switch.
13. High-temperature room thermostat.
14. Current-sensing relay.
15. Leak detector.
16. Time delay relay.
17. Carbon dioxide transmitter.
18. Carbon monoxide and nitrogen dioxide detection system.
19. Ultrasonic flow meter.
20. BTU meter.
21. Hydrogen detection system.
22. Level transmitter serving cooling towers.
23. Refrigerant-monitoring system.
24. Automatic control valves.
25. Damper actuators.
26. Motorized butterfly valves.
27. Field equipment cabinets.
28. Electrical wiring and material.

1.2 RELATED DOCUMENTS

A. Refer to Divisions 01. 21. 22, 26, and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.
B. Refer to Specification 230993 – Sequences of Operation for additional requirements that relate to this section.
C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.3 DEFINITIONS

A. AHU Air Handling Unit.
B. ATC Automatic Temperature Control.
C. BAS Building Automation System.
D. BMS Building Management System.

E. CFM Cubic Feet per Minute.
F. DCV Demand Controlled Ventilation
G. DDC Direct-digital controls.
H. FAS Fire Alarm System.
I. FCU Fan Coil Unit.
J. HVAC Heating, Ventilating and Air Conditioning.
K. I/O Input/Output.
L. LAN Local Area network.
M. LCD Liquid Crystal Display.
N. MER Mechanical Equipment Room.
O. MS/TP Master-Slave/Token-Passing.
P. NEMA National Electric Manufacturers' Association
Q. PID Proportional Integral Derivative.
R. POT Portable Operators Terminal.
S. UPS Uninterruptable Power Supply.
T. VAV Variable Air Volume.
U. VFD Variable Frequency Drive.

1.4 TECHNICAL PROPOSAL

A. Each bidder shall provide with his bid a detailed technical proposal describing all elements of the system. A schematic system layout shall be provided, showing relation of these elements and a description of how they operationally interrelate. Technical specification data sheets shall be provided for all proposed system components and devices. The proposal shall be of sufficient detail to ascertain all elements of the system. At a minimum it must include:

1. Hardware specifications for the proposed equipment.
2. Software Specifications for the proposed system.
3. System architecture and general schematic layout.
4. Control point schedule and control strategies.
5. Workstation Computer Software, including graphics, alarming, trending, etc. capabilities.
6. Construction schedule including work anticipated to be performed during overtime.
7. Installation approach and methodology.
8. Guarantees and warrantees.
9. Training program.
10. Service contract.
11. Unit pricing.
12. List of spare parts.

B. This request for proposal includes the following documents for use in preparing the response.

1. Input/output summary.
2. System architecture.
3. System specifications.

C. Each Bidder shall submit a statement of compliance with the specifications and contract documents. This statement shall consist of a list of numbered paragraphs with "C" for Comply, "D" for Deviation, and "E" for Exception listed next to each as described herein. Final determination of compliance with these specifications shall rest solely with the Engineer and Owner who will require proof of prior satisfactory performance. All non-compliance is subject to Owner and engineer approval.

1. Comply "C" – Proposed system or solution complies with the stated function or requirement.
2. Deviation "D" – Proposed system or solution accomplishes the stated function in a manner different from that described. Provide full description of the deviation.
3. Exception "E" – Proposed system or solution does not comply with project requirement. Provide full description of exception.
4. Note: where a description of a deviation is not provided, it shall be assumed that the submitted proposal complies with the specifications.

D. Each Bidder shall submit qualifications of the proposed project team that is to be involved with the supervision, the engineering and the installation of the BMS with base bid. Each team member resume shall include information about the training and project experience of each individual. Resumes for the following ream members shall be provided, at a minimum:

1. Principal sales engineer.
2. Project manager.
3. Local branch manager.
4. Project engineer.
5. Application engineering staff and the electronic technicians.

E. Each Bidder shall submit information on the following corporate/product qualifications, at a minimum:

1. Number of years in the BMS business (minimum 10 years required).
2. Number of years the proposed system has been manufactured.
3. A written guarantee for the number of years that the proposed system shall be the standard product offering, with parts availability and factory-trained field-support.
4. A summary of the system product line, with field panels, workstations, etc. including a plan for backwards compatibility and non-obsolescence.
5. Description of quality assurance procedures – both hardware and software.
6. Summary of recent projects of similar size and complexity to this project in which the proposed system has been installed.

F. Each Bidder shall submit course catalog descriptions and content that can be used for operator, programmer, and service training of the proposed system.

G. The Bidder is required to identify and submit in their bid proposal any discrepancies that may exist between the bid documents and plans and specifications. Any discrepancies that are not identified for resolution by the Owner prior to the issuance of this subcontract will be the sole responsibility of the Bidder.

H. The Bidder may propose voluntary alternates to this specification. All voluntary alternates must be expressed as line item Adds or Deducts to the Base Bid. Alternates shall include all materials and labor necessary to provide a fully operational system as specified.

1.5 SUBMITTALS

A. Submittals shall include the following:

1. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials and installation and startup instructions for each type of product indicated.

   a. Each control device labeled with setting or adjustable range of control.

b. DDC System Hardware: Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels and operator interface equipment.
c. Control System Software: Include technical data for operating system software, operator interface, color graphics and other third-party applications.
d. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number and product data. Include written description of sequence of operation including schematic diagram.

2. Schedule and specification sheets for control damper actuators, including material and construction details, duct size, damper size, actuator mounting location, and quantity of actuators.
3. Schedule of automatic control valves and motorized isolation valves with specification sheets for each valve. At a minimum, the schedule shall list body pressure rating, close-off pressure rating, Cv factor, pressure drop at specified capacity, rangeability, and valve flow characteristics. Valves shall be sized based on approved equipment shop drawings, not mechanical schedules.
4. 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. Submittal shall include the following as a minimum:

    a. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, instrumentation and control devices.
    b. Wiring Diagrams: Power, signal and control wiring.
    c. System architecture drawing including all communication wiring, network devices, etc. Indicate type of cabling and number of conductors.
    d. Symbol and abbreviation list for control diagrams.
    e. Points list including hardwired and software points.
    f. Manufacturer's technical cut sheets which include a table of contents and an associated sheet numbering system for all pages. Model number shall be circled or pointed with an arrow.
    g. A complete bill of materials specific to each system detailing the equipment to be used, quantity, manufacturer, specific model number and tag number.
    h. List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule and operator notations.
    i. Details of control panel faces, including controls, instruments and labeling.

5. For each BACnet device, submit a PICS document showing the installed device's compliance level.
6. For each Modbus device, submit details for communication parameters and all published point registers available for each unique device.
7. Architectural floor plans indicating proposed locations of all wall-mounted devices (i.e., DDC units, control panels, sensors, thermostats, etc.) and mechanical drawings indicating proposed locations of all temperature, flow and pressure transmitters.

    a. Submit samples of all wall-mounted devices located in occupied spaces. Devices include thermostats, temperature sensors, humidity sensors, CO2 sensors, etc.

8. Mechanical sheet metal shop drawings indicating proposed locations of all static pressure transmitter locations.
9. Mechanical piping shop drawings indicating proposed locations of all temperature, flow and pressure transmitters.

10. All submittals used by field personnel for the installation of equipment shall bear an Engineer's approval stamp.

1.6 OPERATIONS AND MAINTENANCE DATA

A. Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:

1. As-built versions of the submittal shop drawings provided in electronic format and as 11 x 17-inch prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
3. Operation and Maintenance (O & M) Manual.

a. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:

1. Sequence of operation for automatic and manual operating modes for all building systems. The sequences shall cross-reference the system point names.
2. Description of manual override operation of all control points in system.
3. BMS system manufacturers complete operating manuals.

1.7 QUALITY ASSURANCE

A. All work associated with this system shall comply with the following codes:

1. Division 26 Specifications.
2. National Electric Code.
3. National Fire Protection Associated (NFPA) Codes.
4. Local and national building codes.
5. Local and national energy conservations codes.
6. Owner's requirements.

B. Qualifications

1. Wherever possible, furnish all equipment of any equipment type (such as damper actuators, valves, relays, etc.) from one (1) manufacturer.
2. The drawings show the various piping and duct systems schematically. No added compensation shall be permitted for variations due to field conditions.
3. Installing contractor shall be in the business of installing and servicing DDC controls for mechanical systems, temperature and ventilation control, environmental control, lighting control, access and security, life safety and energy management as their primary business.
4. Installer Qualifications: An experienced installer who is the authorized representative of the automatic control system manufacturer for both installation and maintenance of controls required for this Project.
5. Engineering, drafting, programming, and graphics generation shall be performed by engineers and technicians employed by the Building Automation System Contractor.
6. Supervision, checkout and commissioning of the system shall be by the local branch engineers and technicians directly employed by the Building Automation System

Contractor. They shall perform commissioning and complete testing of the BAS system.

7. The system shall have a documented history of compatibility by design for a minimum of fifteen (15) years. Future compatibility shall be supported for no less than ten (10) years. Compatibility shall be defined as the ability for any existing control system component including but not limited to primary control panels, secondary control panels, personal operator workstations and portable operator's terminals, to be connected and directly communicate with any new BMS system equipment without bridges, routers, or protocol converters.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
B. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons while shipping, storing, and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather. The stored products shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.
C. System Software: Update to latest version of software at project completion.

1.9 COORDINATION

A. Coordinate location of temperature sensors, humidity sensors and other exposed control sensors with plans and room details before installation.
B. Coordinate installation of taps, valves, airflow stations, etc. with the mechanical contractor.
C. Coordinate BMS equipment with all relevant divisions including, but not limited to, Fire Alarm to achieve compatibility with equipment that interfaces with that system.
D. Coordinate BMS equipment to achieve compatibility with motor starters and annunciation devices.
E. Coordinate routing of network communication cabling with associated trades.
F. Coordinate power for control units and operator workstation with electrical contractor.

1.10 WARRANTY

A. Warranty the direct digital control system to be free from defects in workmanship and material for a period of one (1) year from completion of final commissioning. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of twelve (12) months from completion of system demonstration.
B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be twenty-four (24) hours.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The BMS contractor shall be an independent contractor not affiliated with the mechanical contractor. Only the NY/NJ branch offices of the controls system manufacturer shall be acceptable. Associated control dealers and VAPS (despite the product line) shall not be eligible to bid on this project.

B. Basis of Design

1. Siemens Desigo CC
   Factory Branch Office NY/NJ
   Contact: Jason Frank
   Email: jason.frank@siemens.com
   Phone: (973) 437-0748

C. Alternate Vendors

1. Honeywell International Inc. Factory Branch Office NY/NJ
2. Johnson Controls Factory Branch Office NY/NJ

D. No other system manufacturers or distributors will be accepted.

2.2 SYSTEM DESCRIPTION

A. The BMS shall consist of a network of standalone microprocessor-based direct digital control units (DDCs). Each direct digital control unit shall perform all specified control and monitoring functions independently. Failure of one (1) control unit shall have no effect upon any other unit in the network. The direct digital control units shall communicate with each other and the servers and workstations. The BMS shall include a full graphic software and graphical operator interface.
B. System input/output point capacity shall be expandable by the addition of DDC units and unitary controllers to the communications network.
C. The operator, through any workstation, shall have the ability to monitor DDC application and sensor data, override set points and schedules, set and reset control points and download programs to the local direct digital control units. A server and workstation network requiring database changes to be made at more than one (1) location shall not be acceptable.
D. Communication protocol between server, workstations, DDC and unitary controllers shall utilize ASHRAE Standard 135 BACnet. In addition, the DDC system shall be capable of providing industry-standard open-protocol communication (BACnet, Modbus, OPC, SOAP, SNMP, XML) to other equipment and/or building systems.
E. The direct digital control units shall be UL 916 (Energy Management Equipment) listed.
F. Communication between the workstations and server shall be by way of a high-speed communications cable utilizing Ethernet technology. The DDC units shall also communicate directly to the server utilizing Ethernet technology.
G. DDC units serving air handling units and water systems shall communicate via BACnet/SC or BACnet/IP. Provide one (1) DDC unit per system unless otherwise specified.
H. Unitary controllers serving VAVs, FCUs, etc. shall communicate via BACnet/SC or BACnet/IP. Unitary controllers utilizing BACnet MS/TP communication shall NOT be acceptable. Provide one (1) unitary controller per terminal unit unless otherwise specified.
I. The furnished BMS shall be complete in all respects so that it shall perform its specified functions in accordance with this section of the specifications. Implementation of all control functions shall be the responsibility of the BMS provider.
J. The entire BMS shall be complete with all necessary control devices, thermostats, valves, motors, relays, switches, dampers, panel, and electric wiring to provide the functions as described hereinafter, regardless of whether or not they are specifically mentioned.
K. The BMS shall be installed complete in all respects by competent personnel, factory-trained by the manufacturer of the control system. All automatic control valves and dampers shall be installed in pipelines and ducts by the respective trade under supervision of the control system provider.

L. All point names, equipment names, equipment labeling, etc., must comply with Owner's equipment naming convention. The vendor is responsible for coordinating with the Owner to determine standards and providing their implementation.
M. All workstation graphics must comply with Owner's standard. The vendor is responsible for coordinating with the Owner to determine standards and providing their implementation.
N. Workstation advisory messages, printouts, logging, alarm formats, etc., must follow Owner's standards.
O. All software provided for this project shall include the manufacturer's certificate and shall be original software purchased for this project. All third-party software shall also be the original software.

2.3 SYSTEM FUNCTIONS AND PERFORMANCE

A. The BMS shall be capable of accepting inputs (analog, digital, pulsed digital, thermistor, and RTD) from field devices, and of producing analog and digital outputs (4 - 20 mA DC, pulse width modulation, and 0-10 VDC) for control and monitoring functions in order to:

1. Adjust control parameters for process-controlled variables.
2. Initiate, define and acknowledge audible alarms.
3. Start/stop motors and position valves and dampers.
4. Initiate shutdowns due to activation of safety devices.
5. Communicate with the servers and workstations.

B. Comply with the following response times and performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current dynamic data within 15 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current dynamic data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command or binary object status alarm and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units (DDC panels) or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 30 seconds. Multiple workstations must receive alarms within 5 seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control:

a. Water Temperature: ± 0.5°F
b. Water Flow: ± 5% of full scale
c. Water Pressure: ± 2% of full scale
d. Space Temperature: ± 0.5°F
e. Ducted Air Temperature: ± 0.5
f. Outside Air Temperature: ± 2°F
g. Dew Point Temperature: ± 1.5°F
h. Temperature Differential: ± 0.15°F
i. Relative Humidity: ± 5%RH
j. Airflow (Pressurized Spaces): ± 3% of full scale
k. Airflow (Measuring Stations): ± 5% of full scale

l. Airflow (Terminal): ± 10% of full scale
m. Air Pressure (Space): ± 0.05 inches of water
n. Air Pressure (Ducts): ± 0.25 inches of water
o. Carbon Monoxide: ± 5% of reading
p. Carbon Dioxide: ± 25 ppm
q. Electrical: ± 5% of reading

2.4 SYSTEM ARCHITECTURE

A. The system architecture shall consist of a network of independent, standalone BACnet IP based primary controllers and BACnet IP based unitary controllers. Each controller shall perform all specified control and monitoring functions independently. Failure of one (1) control unit shall have no effect upon any other unit in the network.
B. The system architecture shall be based on a modular PC network, utilizing industry standard operating systems, networks and protocols.
C. The system shall allow the distribution of system functions such as monitoring and control and graphical user interface etc. across the network to achieve maximum flexibility and performance.
D. Data communications protocol shall be BACnet and shall comply with ASHRAE 135.
E. Each DDC, unitary controller, server, and workstation shall communicate via TCP/IP over Ethernet.
F. Use fiber optic cabling for all Ethernet runs longer than 300 ft.

G. The BMS shall reside on an independent and standalone network supporting BACnet/IP or BACnet/SC. Provide all hardware (routers, gateways, network switches, etc.) and communication cabling (fiber, Ethernet) according to manufacturer's standard architecture layout to achieve network functionality.
H. Contractor shall provide Ethernet network switches which shall be strategically placed throughout the building to cover several floors or several mechanical rooms that are within 300 ft wiring-feet of each other.

I. The BMS and its controllers shall be native-BACnet/SC or shall be BACnet/SC-ready by future firmware upgrade to provide data encryption utilizing secure Websocket protocol with TLS V1.3 (WSS) functioning on TCP/IP.

1. System controllers shall be native-BACnet/SC or shall be BACnet/SC-ready by future firmware upgrade to provide device authentication of those BACnet/SC devices by utilizing the X.509 International Telecommunication Union standard defining the format of PKI certificates.

2. System controllers shall utilize two (2) BACnet/SC hubs per BACnet network for logical function. A primary hub is required for communication to occur on the BACnet/SC network. A secondary failover hub shall be required to ensure communication can resume in the case of primary hub failure.

a. BACnet/SC hubs shall be embedded devices on the BACnet/SC network.
b. BACnet/SC hub-capable controllers shall support routing between different BACnet data link types such as BACnet/SC-to-BACnet/IP routing.
c. BACnet/SC controllers with BACnet/SC hub functionality must support a minimum of 100 node connections per hub.

3. System controllers shall support BACnet/SC node, or BACnet/SC hub+node functionality

(natively or with future firmware upgrade) for the system to function.

4. BACnet/SC must support Certificate Authority (CA) and Certificate Management

    a. BAS provider must provide software tools for Certificate Authority and Certificate Management.
    b. The software tool must be made available to interact with the customer's IT department infrastructure by exchanging certificates and CSR (certificate signing request) for certificate management of the BACnet/SC system for the life of the building automation system.
    c. The BACnet/SC solution must allow for an internal-to-the-organization Certificate Authority (self-signed certificates) utilizing a software tool method capable of generating, singing, and provisioning certificates to the BAS vendor's devices, and revoking certificates completely on its own.
    d. The BACnet/SC Certificate Management must allow for interaction with a trusted 3rd party Certificate Authority (CA) for customers. The BAS vendor provided software tool for generating certificates and provisioning them to the vendor's devices must be able to generate a CSR (Certificate Signing Request) and be able to export the required common Root Certificate (aka Issuer Certificate) on a file level to be signed by a trusted 3rd party certificate authority of the customer's preference as well as be able to import the signed certificate and provision it to the vendor's devices along with the required unique Operational Certificates (aka Client Certificates).
    e. Certificate Management must allow for interoperability with 3rd party vendor BACnet/SC certificate management methods and allow for CA migration (CA1 -> CA2).
    f. The certificates validity period shall be configurable in the vendor's certificate management tool to comply with customer security requirements. This shall be configurable for a minimum of 1 week or years to a maximum of 25 years.
    g. The vendor specific BACnet/SC configuration and management tool from each and every BACnet/SC vendor on the project as well as the corresponding project database containing the Root Certificate must be provided to the customer for ongoing certificate management as well as vendor coordination on the project.

J. Provide one (1) new server located as indicated on the mechanical drawings. Coordinate the final location with the owner.
K. Provide one (1) new workstation located as indicated on the mechanical drawings. Coordinate the final location with the owner.
L. Refer to system architecture drawing for additional information.

2.5 BUILDING AUTOMATION SYSTEM NETWORK

A. The design of the BMS shall network the BMS server, operator workstations, primary control panels and secondary control panels. The network architecture shall consist of multiple network levels. Provide a peer-to-peer Primary Network to connect the existing server, operator workstation(s) and all primary control panels in the building for global system operation. Provide secondary networks to connect from each primary control panel to the secondary control panels of associated terminal equipment.
B. All networked control products provided for this project shall be comprised of an industry standard open protocol internetwork. Communication involving control components (i.e. all types of controllers and operator interfaces) shall conform to the ASHRAE 135 - BACnet standard. Networks and protocols proprietary to one company or distributed by one company

are prohibited.

C. Controllers and software shall be BTL listed at the time of installation.
D. Primary control panels may be connected to the primary network via routers if this follows the standard architecture of a specified manufacturer. Provide additional controllers if required according to manufacturer's standard architecture layout to achieve network functionality. Quantity and locations of routers, network controllers, and supervisory controllers to be coordinated with Engineer.
E. Access to system data shall not be restricted by the hardware configuration of the BMS. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
F. The BMS design shall allow the co-existence of current and future primary control panels and personal computer operator workstations on the same primary network.
G. The BMS contractor shall provide new supervisory controllers/routers as required to connect to all new controllers being installed as part of this project, while still keeping with all requirements such as spare capacity requirements, etc.
H. The network shall not be utilized to send data required by a control algorithm from one controller to another. The data shall be a direct input to the controller containing the control algorithm. If multiple controllers require the same piece of data for a control algorithm, the data shall be an input to each controller.

2.6 RACK-MOUNTED MANAGED NETWORK SWITCH REQUIREMENTS

A. Managed network switch shall be rack-mounted and installed within a network rack furnished by others. Coordinate rack space requirements with associated trades. Provide all required installation kits, power supplies, and software.
B. Each switch shall be installed with 25% of installed spare port capacity. Each spare port shall have a protective cover.
C. Each network switch shall consist of the following, at a minimum:

1. Layer 3 switching functionality.
2. 10/100/1000BaseT(X) Gigabit Ethernet ports.
3. 100/1000Base SFP Slots (fiber connections).
4. Temperature Range: -10 to 60°C (14 to 140°F).

D. Provide MOXA IKS-G6824A Series, or equivalent.

2.7 SERVER REQUIREMENTS

A. Provide one (1) new rack-mounted server. Intent is to install server within an IT rack provided by others.
B. Each server shall consist of the following, at a minimum:

1. Minimum thirty-two (32) GB RAM
2. Two (2) 500 GB SSD in RAID 1
3. Server-grade processor shall have a minimum speed of 3.0 GHz with no less than 4 cores
4. Mouse and 101-key enhanced keyboard.

C. Provide LCD monitor and keyboard with integrated touchpad which shall occupy one (1) rack space.
D. Locate the Operator Workstations in a clean, secure, dry and temperature-controlled environment
E. Provide software licenses for interfacing to the BAS. Load software, configure and setup for

viewing the BAS system.

F. Provide the server with an operating system, such as Windows Server 2016/2019 or other operating systems compatible with the BAS software.
G. Software: Provide the following application software licenses, preloaded on the workstation for the Owner: MS Office Professional, Internet Explorer or equal browser, MS Outlook, Acrobat Reader, CAD Viewer, Antivirus. Set up an icon on the desktop to take the Owner directly to the BAS system login page.

2.8 OPERATOR WORKSTATION HARDWARE

A. Provide one (1) new operator workstation. Operator workstation shall be located with the engineers office.
B. Workstation shall be provided for command entry, information management, network alarm management and database management functions. All real time control functions shall be resident in the DDC Controllers to facilitate greater fault tolerance and reliability.
C. Each workstation shall consist of the following, at a minimum:

1. Minimum sixteen (16) GB RAM
2. One (1) 500 GB SSD
3. Processor shall have a minimum speed of 3.0 GHz with no less than 4 cores
4. Mouse and 101-key enhanced keyboard.

D. Provide a monitor of flat panel type and shall support a minimum display resolution of no less than 1920 x 1080 pixels. The display shall have a minimum of 27-inch visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.
E. Locate the Operator Workstations in a clean, secure, dry and temperature-controlled environment.
F. Provide software licenses for interfacing to the BAS. Load software, configure and setup for viewing the BAS system.
G. Provide the PC with an operating system, such as Windows 10 Pro or Windows Server 2016/2019 or other operating systems compatible with the BAS software.
H. Software: Provide the following application software licenses, preloaded on the workstation for the Owner: MS Office Professional, Internet Explorer or equal browser, MS Outlook, Acrobat Reader, CAD Viewer, Antivirus. Set up an icon on the desktop to take the Owner directly to the BAS system login page.

2.9 BUILDING MANAGEMENT SYSTEM SOFTWARE

A. General

1. Provide software which includes the following:

a. Scheduling and override of building operations.
b. Collection and analysis of historical data.
c. Editing, programming, storage and downloading of controller databases, programs and parameters.
d. The latest version Microsoft Windows environment that allows the user to run several applications simultaneously. Other Windows applications shall run simultaneously with the BMS software including, but not limited to, Word, Excel, Access, etc.
e. Provide a user interface that shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device and "point and click" approach

to menu selection.

f. The operator shall be able to drag and drop information between applications (e.g., click on a point in the alarm screen and drag it into the dynamic trend graph screen to initiate a dynamic trend).
g. Operator specific password access protection shall allow the user to limit workstation control, display and data base manipulation capabilities for each object in the system. An object shall be defined as any input or output point, setpoint, system program, etc. The operator privileges shall "follow" the operator to any workstation or primary control panel that the operator logs on to. Provide a minimum of 1000 passwords.
h. Operators will be able to perform only those commands on the objects available based on their respective passwords. Menu selections displayed shall be limited to only those items defined for the access level of the password used to log-on.
i. An audit trail report to track system object changes that shall record operator initiated actions. These actions shall include, but not be limited to, changes made by a particular person, changes made to a specific piece of equipment and/or changes made during a designated time frame. The changes shall be printed and archived for future reference either on command or automatically, at the operator's option. The operator activity tracking data shall be stored in a tamper proof buffer.
j. Software shall allow the operator to perform commands including, but not limited to:

    i. Start up and shutdown of equipment.
    ii. Setpoint adjustment.
    iii. Add/modify/delete time programming.
    iv. Enable/disable process execution.
    v. Lock/unlock alarm reporting.
    vi. Enable/disable totalization and/or trending.
    vii. Override PID loop setpoints.
    viii. Enter temporary override schedules.
    ix. Define holiday schedules.
    x. Change time/date.
    xi. Automatic daylight savings time adjustments.
    xii. Enter/modify analog warning and alarm limits.

2. Reporting

    a. Reports shall be generated and directed to displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

        i. A general listing of all points in the network.
        ii. List of all points currently in alarm.
        iii. List of all points currently in override status.
        iv. List of all disabled points.
        v. List of all points currently locked out.
        vi. DDC Controller trend overflow warning.
        vii. List all weekly schedules.

3. Scheduling

    a. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide schedules for 365 days in

advance.

b. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule. Temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.
c. Zone schedules shall be provided for each building zone as previously described. Each schedule shall include all points that can be commanded residing within the zone. Each point may have a unique schedule of operation relative to the zone's occupancy schedule, allowing for sequential starting and control of equipment within the zone. Scheduling and rescheduling of points may be accomplished easily via the zone schedule graphic.

4. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display, and database manipulation capabilities as he or she deems appropriate for each user, based on an assigned password.
b. Each user shall have the following: a username (12 characters minimum); a password (12 characters minimum), and an access level (from 1 - 5). The system shall allow each user to change his or her password at will.
c. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
d. A minimum of five levels of access shall be supported as follows.

i. Level 1 = Data Access and Display
ii. Level 2 = Level 1 and Operator Overrides
iii. Level 3 = Level 2 and Database Modification
iv. Level 4 = Level 3 and Database Generation
v. Level 5 = All privileges, including Password Add/Modify

e. A minimum of 100 unique passwords, including user initials, shall be supported.
f. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
g. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
h. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving the operator workstation logged on.

5. Collection and Analysis of Historical Data

a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data shall be stored on hard disk for future diagnostics and reporting.
b. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined

groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred directly to an off-the-shelf spreadsheet package such as Excel. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts.

c. Provide additional functionality that allows the user to view trended data on trend graph displays. Displays shall be actual plots of both historical and/or real-time dynamic point data. A minimum of 10 points shall be viewed simultaneously on a single graph. The user may pause the graph and take "snapshots" of screens to be stored on the hard disk for future recall and analysis. Displays shall include an 'X' axis indicating elapsed time and a 'Y' axis indicating a range scale in engineering units for each point. The 'Y' axis shall have the ability to be manually or automatically scaled at the user's option. Different ranges for each point may be used with minimum and maximum values listed at the bottom and top of the 'Y' axis. All 'Y' axis data shall be color-coded to match the line color for the corresponding point.
d. Static graphs shall represent actual point data that has been trended and stored on disk. Exact point values may be viewed on a data window by pointing or scrolling to the place of interest along the graph. Provide capability to print any graph on the system printer for use as a building management and diagnostics tool.
e. Dynamic graphs shall represent real-time point data. Any point or group of points may be graphed, regardless of whether they have been predefined for trending. The graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the workstation disk for future recall and analysis. As with static graphs, exact point values may be viewed and the graphs may be printed.

6. Dynamic Color Graphic Displays

a. All workstation(s) shall be provided with color graphics. All workstation(s) software shall include graphical viewing and control environment and definition and construction of dynamic color graphic displays.
b. Provide system color graphics for each HVAC system and for each electrical, plumbing and/or piping system that is monitored and/or controlled by the BMS. Provide scaled floor plans indicating equipment location, service and system data as required.
c. Provide color graphic floor plan displays and system schematics for each piece of mechanical equipment, including but not limited to air handling units, chilled water systems and hot water systems to optimize system performance analysis and speed alarm recognition.
d. Provide links on each graphic to PDF files of the associated sequence of operation, flow diagram, and wiring diagram.
e. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.
f. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.
g. The windowing environment of the PC operator workstation(s) shall allow the user to simultaneously view several graphics at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

h. Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays via an off the shelf graphics package.
i. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols.
j. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points that aids the operator in the analysis of the facility.
k. Graphical displays shall contain animation to assist the operator in determining status of the equipment being displayed (e.g., a fan that is energized shall rotate).
l. Provide an automatically updated, dynamic display of the site-specific BMS architecture indicating the status of primary and secondary controllers, PC workstation(s) and networks.
m. Provide a separate dynamic display page of each HVAC (AHU, AC, chiller, cooling tower, fuel oil, etc.), electrical and/or plumbing system connected to the BMS.
n. Provide a separate dynamic display page of each piece of terminal equipment (VAV box, fan coil unit, etc.) connected to the BMS.
o. Provide a separate dynamic display page for each floor or zone. At a minimum, each page shall display the associated space temperature readings and links to equipment located on the floor or in the zone.
p. Provide an additional (10) separate dynamic, graphic display pages at each workstation as required by the operating staff to further assist in daily system operations.
q. Graphics shall incorporate all system integration points communicated via hardware or software gateways and/or interfaces. The origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.

7. System Configuration and Definition

a. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
b. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently add, delete or modify any system object including primary control panel(s), operator workstations(s), secondary control panels, reporting definitions, control loops, energy management applications, time and calendar-based programming, totalization, historical data trending, custom control processes, graphic displays, operator passwords, alarm messages, etc.
c. Definition of operator device characteristics for individual points, applications and control sequences shall be performed using instructive prompting software.
d. Programming shall be performed with the BMS system online and shall not interfere with BMS system operation.
e. Inputs and outputs for any process shall not be restricted to a single primary control panel but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of 1 process as the input to any number of other processes (cascading).
f. Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all database changes shall be performed while the

workstation(s) are on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate primary control panel. Similarly, changes made at the primary control panels shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.

g. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

8. Event Management

a. Event Notification shall be presented to each workstation in a tabular format application and shall include the following information for each event: name, value, event time and date, event status, priority, acknowledgement information, and alarm count.
b. Only events for which the logged-on user has privileges to view shall be displayed on each workstation.
c. The software shall provide the ability to users to limit the list of events displayed at each workstation (e.g. only show fire events at this workstation, no matter who is logged on)
d. Each event shall have the ability to sound an audible notification based on the category of the event.
e. Event List shall have the ability to list and sort the events based on event status, point name, ascending or descending activation time.
f. Directly from the Event List, the user shall have the ability to acknowledge, silence the event sound, print, or erase each event.
g. The interface shall provide the option to inhibit the erasing of active acknowledged events, until they have returned to normal status.
h. The user shall have the ability to navigate to all information related to a selected point in order to command, launch an associated graphic or trended graphical plot, or run a report on a selected point directly from the Event List.
i. Each event shall have a direct link from the Event List to further user-defined point informational data.
j. The user shall have the ability to also associate real-time electronic annotations or notes to each event.
k. Software shall provide the option to configure detailed operating procedures that guide a user through predetermined standard operating procedures for handling critical events. Users shall be able to log completion of each operating step as it is performed.

9. External Data Access

a. The software shall provide the ability to expose configuration properties and real-time values through CSV files, OPC DA, OPC UA, or REST-based Web Services.
b. The software shall provide the ability for external applications to change configuration and real-time values through OPC DA, OPC UA, or REST-based Web Services.
c. The software shall provide the ability for external applications to access historical Trend data through CSV files or REST-based Web Services.
d. External data access must be secured using the level of permissions configured for users and operator workstations.
e. Web service interfaces must allow for exchanging data (object's values, events and trend series) between workstation and external applications such as facility

management systems, enterprise applications, mobile applications or other value-added services.

f. Documentation describing web services interfaces must be included to allow external developers to write applications that leverage the data exchange.

10. Data Security

a. The BAS software must allow that all communication paths between clients and the server are encrypted and protected against replay attacks as well as data manipulation.
b. Any runtime data transfer between the system server and Web Server (IIS) must be allowed to be encrypted by Desigo CC.
c. Communication between any Web Server (IIS) and the Web Clients must be allowed to be encrypted.
d. Passwords must be handled with encrypted storage and transmission
e. The software must support the use of public domain algorithms for cryptographic functions, including AES, DiffieHellmann, RSA, and SHA-2. No self-coded algorithms shall be allowed.
f. All symmetrical encryption must use 256 bit AES or stronger.
g. All asymmetrical encryption must use 2048 bit or stronger.
h. The software must support the use of commercial certificates for securing client-server communications.
i. The software must support the use of self-signed certificates to allow local deployments without the overhead of obtaining commercial certificates.
j. When using self-signed certificates, the owner of the Desigo CC system is responsible for maintaining their validity status, and for manually adding them to and removing them from the list of trusted certificates.
k. The BAS software shall be compatible with the following Virus Scanners:

i. Kaspersky
ii. Avira
iii. McAfee
iv. Bitdefender
v. TrendMicro Office Scan

2.10 GRAPHICS GENERATION AND DISPLAY REQUIREMENTS

A. Graphics Display Requirements

1. Display graphically in up to 256 different colors, the following system information:

a. General area maps showing locations of controlled buildings in relation to local landmarks.
b. Floor plan maps showing heating and cooling zones throughout the buildings in a range of colors which provide a visual display of temperature relative to their respective set points.
c. The colors must be updated dynamically as zone comfort conditions change. Locations of space sensors shall also be shown for each zone.
d. Provide set point adjustment and color band displays.
e. Mechanical system graphics shall show the type of mechanical system components serving a zone through the use of a pictorial representation of components.

2. Graphics shall provide current values and status of all I/O points being controlled and applicable to each piece of equipment including analog readouts in appropriate engineering units at appropriate locations on the graphic representation.
3. The engineering workstation shall allow receipt of alarms and messages while in a functional mode other than energy management, i.e., incoming alarms shall be displayed while the operator is in a word processing, spreadsheet, or other operating mode.
4. The system must automatically display alarms on a second screen, provide operator ability to respond to an alarm, and return to the exact position left in the previous functional mode.
5. The building operator shall be able to communicate and direct control functions through the use of a "mouse" operator interface to monitor and control functions and sequences within the system.
6. Blocks: Programming, scheduling and set point changes shall be accessible for modification on each menu for the associated equipment. Operator shall be able to automatically download changes from the central site to the appropriate program for the equipment being controlled. Operator shall be able to upload parameters set point information and schedules from the field modules to the central station.
7. Input Format: Operators shall be able to control system functions Based on their password level. The primary operator interface shall be via a mouse type cursor controller.
8. Operator Commands shall be menu driven in the graphics database to include:

    a. After the operator selects the desired object item or menu, the system shall display either the status of selected object item or the allowable options available.
    b. Upon entry of a command to the point or points desired as described above, the system shall, before performing a command, respond with an echo of the request.
    c. This echo feedback shall include the command requested and any entered data.
    d. System shall include error monitoring software for user's input error.
    e. A "system" shall consist of a logical grouping of data points, related to a piece of mechanical equipment, an energy distribution system, or an architectural service area.
    f. For example, in some cases, it may be desired to display, as a single system, a space temperature with its associated air handling unit, and in other cases to display all space temperatures on a floor or in a building.
    g. The system shall allow such determinations to be made without regard to the physical hardware locations of a point or group of points.
    h. Likewise, the system shall accommodate future changes of system grouping and operations without field hardware changes.

9. Displays and logs shall contain a header line indicating date, day-of-week, and time. Output displays or logs of a point or group of points shall contain, as a minimum, the following information:

    a. Graphic presentation of the System
    b. User name of point
    c. Point descriptor (Haystack convention)
    d. Current value/status
    e. Associated engineering units
    f. Alarm description
    g. Trend description

10. User names, point descriptors, and engineering units shall be operator definable on a per

point basis.

11. Space Temperature Representation: Utilize a contiguous band of colors each corresponding to actual zone temperatures relative to the desired heating and cooling set points.

    a. The ideal temperature shall be shown as a green color band. This color band corresponds to the dead-band between the onset of mechanical heating or cooling.
    b. Show temperatures slightly warmer than ideal in yellow and even warmer temperature in orange.
    c. Temperatures slightly cooler than ideal shall be light blue
    d. Even cooler temperatures shall be dark blue.
    e. Alarm colors shall be in red.

12. Passwords: User Access Restriction.

    a. Operator sign-on shall require an assignable password.
    b. Each operator can be assigned to one of ten levels of system access.

B. Graphics Generation Requirements

1. Construction: Permit the easy construction of infinitely variable shapes and sizes through the use of the mouse pointing device. A selection of 256 colors and various fill textures, line types and text styles shall all be accessible through the use of the mouse interface. The software shall resemble many of the computer aided design programs currently available and allow graphics to be easily moved, edited, added or deleted. Graphics software shall be fully implemented and operational to accomplish the following:

    a. Create a new graphic picture
    b. Modify a portion of a graphic picture
    c. Delete a graphic picture, or any portion thereof
    d. Call up a graphic picture
    e. Cancel the display of a graphic picture
    f. Assign conditions which automatically initiate the display
    g. Overlay alphanumeric and graphics
    h. Save the graphic picture
    i. Display latest process data fully integrated with the graphic display
    j. Display Live Graphical Software Programs
    k. The central station must be able to generate standard ASCII file formats to allow use with third-party software to generate and store owner-designed reports.

C. Graphics Application Requirements

1. All graphics shall be available with the same look and functionality whether they are displayed at an installed client console or in a browser.
2. User shall be able to add/delete/modify system graphics for floor plan displays and system schematics for each piece of mechanical equipment (including, air handling units, chilled water systems, hot water boiler systems, and room level terminal units) from standard user interface without the need of any external or specialized tools.
3. The software shall include all necessary tools and procedures for the user to create their own graphics.
4. The software shall provide the user the ability to display real-time point values by animated motion or custom picture control visual representation.

5. The software shall provide animation that depicts movement of mechanical equipment, or air or fluid flow.
6. The software shall provide users the ability to depict various positions in relation to assigned point values or ranges.
7. The software shall provide the ability to add custom gauges and charts to graphic pages.
8. The software must include a library of at least 400 standard control application graphics and symbols for visualizing common mechanical systems, including fans, valves, motors, chillers, AHU air handling systems, standard ductwork diagrams, piping, and laboratory symbols.
9. The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.
10. The Graphics application shall be capable of automatically assigning the appropriate symbol for an object (point) selected to be displayed on the graphic Based on what the object represents (fan, duct sensor, damper, etc.) when the object is placed on a graphic.
11. The Graphics application shall allow a user to manually override the automatically assigned symbol for an object when a different symbol is desired.
12. The user shall have the ability to add custom symbols to the symbol library.
13. The software shall permit the importing of scanned pictures and images for use in graphics with support of JPG, PNG, and SVG files.
14. Graphics must be automatically associated to any points or system objects that are rendered on the graphic, so that selection of a system object will allow a user to simply navigate to any associated graphic, without the need for manual association.
15. The software must allow users to command points directly off graphics application.
16. Graphic display shall include the ability to depict real-time point values dynamically with text or animation.
17. Graphics viewing shall include the ability to switch between multiple layers with different information on each layer.
18. Graphics shall include a decluttering capability that allows layers to be programmatically hidden and displayed Based on zoom level.
19. Graphics shall be capable of displaying the status of points that have been overridden by a field HAND switch, for points that have been designed to provide a field HAND override capability.
20. The software must provide the ability to create dashboard views consisting of gauges and charts that graphically display system and/ or energy performance.

2.11 BACNET BUILDING CONTROLLER HARDWARE (B-BC)

A. Provide all necessary hardware for a complete operating system as required. The Building Controller shall be able to operate as a standalone panel and shall not be dependent upon any higher-level computer or another controller for operation.
B. Basis of Design: Siemens PXC Series.
C. This controller shall have the BTL listing and meet the BACnet device profile of a Building Controller (B-BC).

    1. Controller shall support BACnet/SC and BACnet/IP.

D. This level of controller shall be used for the following types of systems:

    1. Chilled water systems.

2. Hot water systems.
3. Air handling units.
4.

E. Computing power and memory minimum:

1. A stand-alone, multi-tasking, multi-user, real-time 1.2GHz digital control microprocessor module.
2. Inputs shall be 16-bit minimum analog-to-digital resolution
3. Outputs shall be 10-bit minimum digital-to-analog resolution
4. Memory module (2GB, minimum) to accommodate all Primary Control Panel software requirements, including but not limited to, its own operating system and databases (see Controllers Software section), including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, dial-up communications.
5. Real time clock and battery
6. Data collection/ Data Trend module sized for 10,000 data samples.
7. Flash Memory Firmware: Each Building Level Control Panel shall support firmware upgrades without the need to replace hardware.

F. Communication

1. 2-Port Ethernet switch cabling compatible with star, bus or daisy chain topology.
2. WLAN connection for service, commissioning and firmware upgrade.
3. Web user interface is accessible over HTTP or securely over HTTPS.
4. Individual 3rd Ethernet port for local service/tools connection.

G. Input and Output Points Hardware

1. Input/output point expansion modules shall be installed as required to include 20% spare capacity of points.
2. Input/output point modules shall have removable terminal blocks.
3. Monitoring of the status of all hand-off-auto switches.
4. Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.
5. Local status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Each primary control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
6. Graduated intensity LEDs or analog indication of value for each analog output.
7. Optional HOA (hand-off-auto module) with software configurability and LED status indicators.

H. Code compliance

1. Approvals and standards: UL916; CE; FCC
2. Provide UL864-UUKL where called for in the sequences of operations.

I. Accessories:

1. Appropriate NEMA rated metal enclosure.

2. Power supplies as required for all associated modules, sensors, actuators, etc.

J. The operator shall have the ability to manually override automatic or centrally executed commands at the primary control panels via local, point discrete, on-board hand/off/auto operator override switches. If on board switches are not available, provide separate control panels with HOA switches. Mount panel adjacent to primary control panel. Provide hand/off/auto switch for each digital output, including spares.
K. Panel setup, point definitions and sequencing diagrams shall be backed up on EEPROM memory.
L. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all Building Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.
M. Building Level Controllers shall have the capability to serve as a gateway between Modus subnetworks and BACnet objects. Provide software, drives and programming.
N. Spare Capacity: Provide enough inputs and outputs to handle the equipment shown to be "future" on drawings and 20% more of each point type. Provide all hardware modules, software modules, processors, power supplies, communication controllers, etc. required to ensure adding a point to the spare point location only requires the addition of the appropriate sensor/actuator and field wiring/tubing.
O. Environment.

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. 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 49°C (32°F to 120°F).
3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
4. Controller hardware shall be optionally suitable for rooftop environments.

2.12 BACNET ADVANCED APPLICATION CONTROLLERS (B-AAC)

A. Provide all necessary hardware for a complete operating system as required. The Advanced Application control panel shall be able to operate as a standalone panel and shall not be dependent upon any higher-level computer or another controller for operation.
B. Basis of Design: Siemens DXR.
C. Controller software shall be capable of BACnet communications. The controller shall have demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet device profile as specified in ANSI/ASHRAE 135.

1. Controller shall support BACnet/SC and BACnet/IP.

D. Communication: Controller shall support the BACnet IP Data Link Layers.
E. The software programs specified in this section shall be provided as an integral part of controllers and shall not be dependent upon any higher-level computer or another controller for execution.
F. Controllers shall have the ability to perform energy management routines including but not limited to

1. Scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides
2. Automatic daylight savings time switch over
3. Night setback control

4. Economizer switch over using enthalpy, dry bulb or a combination
5. Peak demand limiting,
6. Temperature-compensated duty cycling
7. Heating/cooling interlock
8. Supply temperature reset
9. Priority load shedding
10. Power failure restart

G. The software shall have a routine for automatic tuning of control loops
H. System Security in the Field Panel

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
3. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
4. Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.

I. User Defined Control Applications:

1. Controllers shall be fully-programmable. Controllers shall execute custom, job-specific sequences to automatically perform calculations and special control routines. Factory installed or pre-configured sequences shall only be allowed if they exactly match the sequence specified herein.
2. Programs shall combine control logic, control loop algorithms, and energy management routines
3. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.
4. Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task oriented information from the user manual.

J. Input/Outputs

1. Inputs shall be 16-bit minimum digital resolution
2. Outputs shall be 10-bit minimum digital resolution
3. The following I/O port types shall be available on the controller

a. Universal Input (software configurable):

i. Digital Input choices:

1. Pulse Accumulator
2. Contact Closure Sensing
3. Dry Contact/Potential Free inputs only
4. Digital Input (10 ms settling time)
5. Counter inputs up to 20 Hz, minimum pulse duration 20 ms (open or closed)

ii. Analog Input Choices:

1. 0-10 Vdc

2. 4-20 mA
3. 1K Ni RTD @ 32°F (Siemens, DIN Ni 1K)
4. 1K Pt RTD (375 or 385 alpha) @ 32°F
5. 10K NTC Type 2 or Type 3 Thermistor
6. 100K NTC Type 2 Thermistor

b. Universal Input or Output (software configurable):

i. All of the above input types
ii. Analog Output Types:

1. 0 to 10 Vdc @ 1 mA max

c. Super Universal Input or Output (software configurable):

i. All of the above input types
ii. All of the above output types
iii. Super digital output type:

1. 0 to 24 Vdc, 22 mA max. (for controlling pilot relay)

iv. Super Analog Output Choices:

1. 0 to 20 mA @ 650 Ω max.

4. Provide software configurable I/O ports such that a programmer make a port either an input or an output

K. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for the operating system software and firmware.
L. Database Restore: Each controller shall automatically save the latest programmed database. The controller shall be able to automatically restore a lost or corrupt database without involvement from the operator.
M. Each Control Panel shall support firmware upgrades without the need to replace hardware.

2.13 BACNET APPLICATION SPECIFIC CONTROLLERS (B-ASC)

A. Each Application Specific Controller shall operate as a stand alone controller capable of performing its user selectable control routines independently of any other controller in the system. Each Application Specific Controller shall provide standard applications and programmability to provide both reliability and flexibility. Each application specific controller shall be a microprocessor based, multi tasking, digital control processor.
B. Basis of Design: Siemens DXR.
C. Configurable control applications. Each Application Specific Controller model must have a set of pre-loaded, selectable and field-adjustable control applications appropriate for the secondary HVAC equipment that the controller model is intended to control. Specific applications must be configurable to meet the user's control strategy requirements, allowing for additional system flexibility.
D. Programmability: Application Specific Controllers shall be programmable. Program language shall be graphical.
E. Each Application Specific Controller model must have a set of pre-loaded, selectable and

field-adjustable control applications for lighting equipment control, independent from or in conjunction with the HVAC control applications, which can be enabled if the appropriate lighting control devices are connected.

F. Each Application Specific Controller model must have a set of pre-loaded, selectable and field-adjustable control applications for shading equipment control, independent from or in conjunction with the HVAC control applications, which can be enabled if the appropriate shading control devices are connected.

G. The Application Specific Controller shall include all point inputs and outputs necessary to perform the specified HVAC control sequences. The controller shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Controllers shall provide outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.

1. Analog inputs shall be software configurable to accept sensors using 0-10v (such as RH or CO2 sensors), NTC3k, NTC10k, NTC100k, Ni1000, PT1K 385, and resistance sensors of 1000Ω, 2500 Ω, 10K Ω, and 100k Ω . 24vDC power to drive active sensors shall be an option available from the controller.
2. Digital input
3. Analog Outputs shall support 0-10v HVAC control signals.
4. Digital outputs shall be AC 24V high-side switching triacs, able to switch loads of 250 mA / 6 VA per output.
5. Every installed Application Specific Controller shall be prepared for the addition of occupancy, CO2 and humidity sensors
6. Additional sensors and output modules for occupancy, lighting and shade control within the same space as the HVAC control shall be connected as needed via a sub-network connection on each Application Specific Controller
7. The Application Specific Controller shall be compatible with a Siemens Room Unit which combines a display with CO2, temperature and humidity sensing in 1 wall device.
8. The Application Specific Controller shall be compatible with a Siemens Room Unit which combines a display with temperature sensing and configurable switches for lighting, shade and scene control in 1 wall device.

H. Application Specific Controller communication

1. Communication over floor level network shall be BACnet IP over Ethernet unless otherwise required by the application.
2. Each controller that uses BACnet IP shall provide at least two Ethernet ports allowing the controllers to be wired in a daisy-chain configuration of up to at least 20 controllers per chain, utilizing standard Ethernet cables of up to 300ft in length between each controller.

I. The Application Specific Controller shall have the BTL listing and meet the BACnet device profile of an Application Specific Controller (B-ASC) as specified in ANSI/ASHRAE 135.

1. Controller shall support BACnet/SC and BACnet/IP.

J. The Application Specific Controller shall provide for control of each piece of equipment, including, but not limited to the following:

1. Variable Air volume (VAV)
2. Constant Air volume (CAV)
3. Hot water and electric reheat Coils (RH)

4. Fan Coil Units (FCU)
5. Fan Powered Boxes (FPB)
6. Unit Conditioners
7. Unit Ventilators
8. Baseboard radiator
9. Chilled/heated ceiling panels
10. DX cooling and chilled water coils

K. Coordination between Application Specific Controllers. In situations where more than one controller is serving a common space, it must be possible through configuration only (not reprogramming) to subordinate one or more Application Specific Controllers to another Application Specific Controller allowing multiple controllers to coordinate HVAC control in a large space.

L. Application Operating Modes - All of the following operating modes shall be supported, with configurable operation of each controlled device during each mode.

1. Comfort, Standby (Pre-comfort), Economy, and Building Protection modes

    a. Comfort: Space is occupied
    b. Standby (Pre-comfort): Space has been or will be unoccupied for a short time
    c. Economy: Space has been or will be unoccupied for a longer time
    d. Building Protection: Space has been or will be unoccupied for a more than a day

2. Configurable set points and limits for each mode.

    a. The operating mode can be changed by system schedule or command or by conditions in the space such as by presence detection.
    b. All controlled devices shall respond to changes in operating mode in a configurable way such as set point resets after a configurable time to optimize energy consumption.

M. Room Units / HMIs shall provide an intuitive user alert to indicate energy-efficient operation or when there is unnecessary energy consumption, and provide occupants with a one-touch release to return to efficient, comfortable control. Energy efficient operation shall be determined by configurable and programmable algorithms provided by the Application Specific Controller and shall include (but not be limited to) the following conditions:

1. Temperature set point is set outside customer-specified limits.
2. Fan Speed is overridden to a higher speed than is required for automated temperature control.

N. The energy efficiency status for each Application Specific Controller and space shall also be available as BACnet object at the BMS for operating and monitoring.

O. Scene control. The Application Specific Controller shall provide a set of configurable and field-adjustable presets of HVAC modes that can be activated by pressing assigned buttons on the Room Unit / HMI.

P. Application Specific Controller Configuration and Commissioning Tool

1. Provide industry standard, commercially available laptop to host the Application Specific Controller Configuration and Commissioning Tool. The tool shall plug directly into all controllers as described below:
2. Functionality of the Configuration and Commissioning Tool connected to any Application

Specific Controller shall include:

a. Provide connection capability at either the controller, a related room unit, through a BACnet router or through a Siemens Apogee Field Panel controller to access controller information.

    i. When connected via a related room unit to a controller, the tool shall be able to access information of the controller the room unit is connected to and all controllers connected to the same MS/TP or IP network.
    ii. Connection of the Tool to a controller shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.
    iii. Tool access to controller shall be password-controlled. Password protection shall be configurable for each operator based on function, points (designating areas of the facility), and edit/view capability.

b. Provide device discovery, configuration and setup for addressing and network management of multiple devices from one connection point (location) in parallel.
c. Select, view, command, change, and enable/disable features and functionality of the control application.
d. Load pre-designed templates of configuration settings and allow copying of templates to other controllers in order to speed the commissioning process.
e. Provide status, setup, balancing and control reports to support commissioning and troubleshooting activities.
f. Backup and restore of application configurations
g. Air flow balancing.

    i. For every air flow sensing channel in the Application Specific Controller control application, the Tool shall offer an interface and menu specifically designed to support the Test, Adjust, and Balance functions. Through the balancing menu, the controller enables the following operations:

        1. Select the operating point for the test from a list of named operating points, including maximum and minimum cooling, maximum and minimum ventilation and maximum and minimum heating.
        2. Accept the balancer's flow measurement as a manually entered value.
        3. Automatically calculate and display the revised flow calibration factor.
        4. Apply the new calibration factor on command.

    ii. The Application Specific Controller shall maintain a BACnet object reflecting the TAB state of the controller as: Initial, Balancing, Balanced. The Application Specific Controller records data representing the TAB process, and stores for later retrieval. The controller delivers the data when called for producing reports. Stored data includes:

        1. Air balancer's air flow measurement.
        2. Controller's air flow measurement after correction.
        3. Named test point (max cooling, etc.).
        4. Initial calibration factor.
        5. Applied selected calibration factor

iii. The tool should allow configuring, loading and balancing multiple controllers from one connection point (location) in parallel
iv. The Ethernet / IP Application Specific Controller models shall provide web pages for troubleshooting and operation and monitoring which can be accessed via a standard web browser

Q. Each Application Specific Controller shall, at a minimum, be provided with:

1. Appropriate NEMA rated enclosure
2. Power supplies as required for all associated modules, sensors, actuators, etc.
3. Each controller measuring air volume shall include a differential pressure transducer
4. Approvals and standards: UL916 PAZX; CUL; FCC

R. Each Application Specific Controller shall continuously perform self-diagnostics on all hardware and secondary network communications. The Application Specific Controller shall provide both local and remote annunciation of any detected component failures or repeated failure to establish communication to the system.
S. Power Supply. The Application Specific controller shall be powered from a 24 VAC source and shall function normally under an operating range of -15% / +20%.
T. All controller configuration settings and programs shall be stored in non volatile memory. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
U. Environment. The controllers shall function normally under ambient conditions of 23 to 122°F (-5 to 50°C) and 5% to 95% RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.

2.14 ALARM PROCESSING

A. Alarms shall be classified by their alarm type. The facility shall be provided for enabling and disabling each individual alarm on the system.
B. Once generated, the alarm shall be processed by its associated alarm type as defined in the I/O Point Schedules. The alarm types shall be as follows:

1. General Mismatch
2. Critical Mismatch
3. General Binary
4. Critical Binary
5. General Analog
6. Critical Analog
7. Alarm Inhibition

C. Consequential alarm suppression algorithms shall be provided to limit the alarms annunciated on the DDC System to those associated with the source of the initial alarm condition e.g. fire alarms shall not initiate mismatch alarms, restoration of power following a power failure shall not initiate mismatch alarms etc.

2.15 CONFIGURATION

A. Configuration data shall be stored in the DDC Controllers or the Terminal Unit Controllers. Configuration data shall include but not be limited to the following:

1. The unit applicable (deg F, GPM's, inches, etc.).

2. The point identifier (minimum of 12 characters).
3. The point alarm message if applicable (minimum of 80 characters).
4. The point descriptor (minimum of 32 characters).

2.16 DDC STANDARD PROGRAMS

A. The device schedules included in this Specification provide details of inputs monitored and outputs controlled by the DDC System. All point types are described under Controllers elsewhere in this Specification. The DDC System shall allow for the following point functionality and standard programs to be available:

1. Point Override
2. Manual Start/Stop
3. Fixed Time Program
4. Optimum Start/Stop
5. Control Loops
6. Rotational Point
7. Run Time Totalization
8. KWH calculations
9. Anti-Short Cycling
10. Staggered Start
11. User Definable Software
12. General Control Requirements

2.17 INTEGRATIONS

A. The BMS shall utilize and be compatible with industry-standard integration protocols (BACnet and Modbus) for subsystem integration. Coordinate integration protocols with subsystem manufacturer.
B. In addition to the above, the BMS shall be integrated with all pump and fan VFDs via BACnet IP. All software points shall be made available at the BMS for monitoring.

2.18 CONTROL PANELS

A. Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide laminated as-built wiring diagrams, flow diagrams, etc. related to the system being controlled inside the associated cabinet. Each control panel shall be clearly and permanently labeled with the controller designation and indication of the mechanical equipment served.
B. Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
C. Field equipment panels located indoors shall be NEMA 1. Field equipment panels located outdoors or subject to outdoor air conditions shall be minimum of NEMA 3R, provided with internal electric heater and cooling fan.
D. Coordinate installation of the control panels with the engineer/architect.
E. Coordinate power for the panels with the electrical contractor.
F. All control panels shall be provided with DIN Rail mounted screw terminal blocks. Field wiring shall be connected to the screw terminal blocks. It is not acceptable to terminate any field wiring directly to the DDC controller or any panel devices such as relay and transducers. The screw terminal blocks located/attached to the DDC controller alone does not comply with this requirement.
G. All control devices such as relays, transformers, transducers, power supplies, associated I/O

devices, etc. shall be installed inside the panel, not at the starter or electrical junction box.

H. All panel wirings shall in be installed in Panduit and wiring duct. This shall include but not be limited to wiring from the DDC controller to the terminal block, between DDC controller and relay (and other panel mounted control devices), power wiring for the controller, communication, etc.

I. Primary control panels shall be assembled, wired, pre-commissioned and tested by union-electricians in a controlled factory environment prior to being shipped to the jobsite. Field assembly of primary control panels shall not be acceptable.

J. Accessories

1. Maintained Panel-Mounted: Relay shall be "ice-cube" style with corresponding DIN rail mountable socket. Outputs shall be SPDT, DPDT, 3PDT, or 4PDT type rated for 10A switching capacity. Each shall be provided with manual check buttons and LED indicators. Relay shall be RH Series as manufactured by IDEC, or as approved by Engineer.
2. Maintained Field-Mounted: Relay shall be enclosed with LED indicator. Output shall be SPDT type rated for 10A switching capacity. Relay shall be RIBU1C as manufactured by Functional Devices, or as approved by Engineer.
3. Time Delay Relay

    a. Time delay relays shall be of the on-delay (delay-on-make) or off-delay (delay-on-break) type, based on the application. The timer shall have a single adjustable time range and contain an analog user input (potentiometer, dial, switch, etc.). The timer shall have an electromechanical relay output (DPDT type), rated for a minimum of 5 amps, and shall be powered by an external AC or DC power supply. The timer shall be capable of operating at an ambient temperature range of 13°F to 140°F.
    b. The time delay relay repeatability accuracy shall be ± 0.5% with an overall accuracy of ± 1.0% and shall have an electrical life of 100,000 operations at rated load. Timing adjustment shall be capable of user adjustment, specific to the application at use. Time delay relays shall be as manufactured by Square D, ASCO, Agastat or as approved by the Engineer.

2.19 SENSORS

A. All control signals shall be via 4-20 mA or 0-10 VDC loops.

B. Input/output sensors and devices shall be closely matched to the requirements of the DDC for accurate, responsive, noise-free signal input/output. Control input response shall be high sensitivity and matched to the loop gain requirements for precise and responsive control. Thermistors are acceptable for VAV terminal applications.

C. Temperature Sensors

1. Provide the following instrumentation as required by the monitoring, control, and optimization functions. All temperature sensors shall use platinum RTD elements only, nickel or silicon RTD's and thermistors are not acceptable.
2. Temperature Transmitter Assembly – Airstream averaging type

    a. The assembly shall consist of a capillary type 1000-ohm platinum RTD housed in a flexible sheath contained in housing suitable for duct mounting.
    b. Accuracy: ±0.25°F

3. Temperature Transmitter Assembly – Airstream non-averaging type

    a. The assembly shall consist of an insertion type 1000-ohm platinum RTD mounted on

a 12-inch probe (or duct diameter) contained in a housing suitable for duct mounting.
b. Accuracy: ±0.25°F
c. For outside air application mount with weather protection and sun shield.

4. Low Temperature Limit Switch (Freezestat) – Airstream

   a. The low temperature limit switch shall be of the automatic reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. Provide one freezestat per coil section or a maximum of 18 square feet whichever is more provides more coverage.

5. Temperature Transmitter – Space

   a. The assembly shall consist of a 1000-ohm platinum RTD contained in a decorative ventilated enclosure similar in appearance to room thermostats.
   b. Accuracy: ±0.25°F
   c. Temperature transmitters for terminal unit applications (such as VAVs, FPBs, FCUs, etc.) shall utilize industry-standard KNX protocol.
   d. Cover type (i.e. indicating, adjustable, blank), colors, and final installation locations shall be as reviewed approved by the architect, owner, and engineer. In general, occupied spaces (i.e. offices, conference rooms, etc.) shall be provided with indicating temperature display (LCD) and setpoint adjustment (±3°F); transient spaces (i.e. open office area, hallways, etc.) shall be provided with blank non-indicating and non-adjustable sensors. Note: All adjustable sensors are subject to ADA requirements.

6. Temperature Transmitter – Space (Public Areas)

   a. The assembly shall include button-type sensing element with 1000-ohm platinum RTD.
   b. Coordinate the final button material and finish with the architect
   c. Install in the architectural finishes per the manufacturer's instructions. Include all necessary hardware such as spacers, etc. required for proper sensor operation with interference from surrounding environmental conditions.

7. High Temperature Thermostat – Space

   a. High temperature room thermostat shall contain bi-metallic switches, SPDT rated for 5 amps at 120 VAC

8. Temperature Transmitter – Liquid Immersion

   a. Sensing element RTD
   b. Temperature range Suitable for application
   c. Output signal 4-20 mA
   d. Accuracy ±0.15°F
   e. Provide Type 304 stainless steel thermowell for each liquid immersion temperature sensing element.

D. Humidity Sensors

1. Relative Humidity – Duct

a. Sensor humidity range 0 to 100%
b. Accuracy ±2%
c. Sensing element Digital Sensor IC (capacitive)
d. Output signal 4-20 mA/0-5V/0-10V selectable
e. Calibration adjustment adjustable to ±5% RH

2. Outside-Air Sensors: Provide duct-mounted sensor with element guard and mounting plate.

E. Carbon Dioxide Transmitters

1. Carbon Dioxide – Space

a. Sensor range 0-2000 ppm
b. Accuracy ±(30 ppm + 4% of measured value)
c. Provide with readable LCD display where indicated in the sequences or drawings
d. For rooms with temperature sensing as well, provide a combined temperature/humidity sensor or provide units with matching cover.

2. Carbon Dioxide – Duct

a. Sensor range 0-2000 ppm
b. Accuracy ±(50 ppm + 2% of measured value)
c. Output signal 4-20 mA/0-5V/0-10V selectable

F. Pressure Sensors/Switches

1. Airside Differential Pressure Transmitter

a. Non-directional sensor with suitable range for expected input, and temperature compensated.
b. Assembly to include integral mounting bracket
c. Accuracy ±1% of Full Scale
d. Output 4 to 20 mA or 0-10 VDC (selectable)
e. Static Pressure Ranges

i. Duct 0 to 5 inches wg.
ii. AHU Filter 0-to-1-inch wg. (Coordinate with manufacturer)

2. Airside Static Pressure Switches

a. Diaphragm type air differential pressure switches with die cast aluminum housing, adjustable setpoint, minimum 5 amp switch rating at 120VAC, SPDT switches. Switch pressure range and set point shall be suitable for the application. High and low ports shall be 1/8 inch NPT connected to angle type tips designed to sense pressure.
b. Reset-type based on applications:

i. Fan status Automatic Reset

ii. Hi/Lo Static Safety Manual Reset

c. Provide AFS Series as manufactured by Cleveland Controls or pre-approved equal.

3. Water Differential Pressure Transmitter

a. Wet-to-wet differential pressure transmitter shall be direct acting for gas or liquid service. Pressure range shall be suitable for system and applications.
b. Transmitter shall meet the following criteria:

i. Supply Voltage 15 - 30 VDC
ii. Output 2-wire proportional output, 4 to 20 mA
iii. Housing NEMA 4 with LCD Display
iv. Operating Temp -4ºF - 185ºF
v. Accuracy ±1.0% FS

c. Transmitter shall be furnished with factory-assembled 5-valve manifold.
d. Provide Setra Model 231 or approved equal.

G. Current-Sensing Relays

1. Relay shall be field-adjustable for detecting AC current levels in equipment served. Relay shall be non-latching and shall have no time delay. Nominal input voltage and current-sensing range shall be selected based on electrical characteristics of equipment served. Relay shall be installed on one (1) lead of the load side of motor feed. Relay contacts shall be Form C-rated for 5A at 120 VAC.

H. Leak Detection

1. Point-Type Leak Detector: Leak detector shall provide single-point detection of leaks. The sensing probe shall be gold-plated to prevent corrosion. The sensor shall be provided with adjustable mounting brackets to allow for height and leveling adjustment. Sensing probes shall be adjusted to 1/8 in. of floor. Power requirements shall be 24 VAC, 100 mA. Enclosure shall be NEMA 1. Output relays shall be 2 Form C, 3A rating at 24 VAC. Detector shall be manufactured by Liebert Model LT-410 or as approved.

I. Airflow Measuring Station

1. Airflow-temperature-measurement station shall be capable of monitoring airflow and temperature rates. Sensors shall use thermal dispersion technology with multiple temperature and velocity point on each measurement point. The system shall be factory-tested prior to shipment and not require calibration or adjustment of the life of the equipment. Each sensor probe shall be provided with a UL plenum-rated connecting cable with circular terminal connectors and gold-plated contacts. Connecting cable shall be a minimum of 10 feet of length (up to 50 feet) for each probe. Sensor probes shall be of plug-and-play design and do not have to be matched to a specific transmitter. All sensor calibration data shall be stored in the sensor probe.
2. Sensors

a. Sensors shall be factory-calibrated at a minimum of sixteen (16) airflow rates and three (3) temperatures to NIST-traceable standards for both airflow and temperature. Each sensing point shall independently measure airflow and

temperature prior to averaging. Installed accuracy shall be percent of reading and demonstrated at both maximum and minimum airflow rates for each measurement location. Airflow sensor accuracy shall be ±2%.

b. Provide a minimum of 4 sensors for every 2 sq. ft. of AHU or duct cross-section or as per manufacturer's requirements to meet specified accuracy and performance.

3. Transmitter

a. Transmitter shall be microprocessor-based and capable of processing up at least to sixteen (16) independent sensing points per location. All connectors and interconnects shall have gold-plated contacts. The transmitter shall operate on 24 VAC and be internally fused and protected. The transmitter shall have a 16-character alphanumeric LCD display for airflow, temperature and system diagnostics. Analog output signals shall be field-selectable (0 - 10 VDC or 4 - 20 mA). All inputs and outputs shall be fused, protected and internally insulated from the 24 VAC power supply. The sensor shall be capable of continuously performing sensor and transmitter diagnostics and perform a full-system check on power-up. The transmitter shall be capable of indicating individual sensor airflow and temperature readings on the LCD display. The enclosure shall be aluminum alloy for indoor use and shall be capable of operating over a temperature range of 30°F to 120°F.
Transmitter accuracy shall be 3% to 10% of reading. Repeatability shall be 0.25%. Probe construction shall be 304 stainless steel, including housing and mounting feet. Temperature sensor accuracy ±0.15°F. Temperature range shall be -20°F to 160°F.

4. Basis of Design: Ebtron Gold Series.

J. Carbon Monoxide and Nitrogen Dioxide Gas Detection System

1. Provide a gas detection system in the Garage. System shall be comprised of a central controller with strategically placed gas sensors. Quantity of sensors shall be as per manufacturer. At a minimum, there shall be one (1) gas sensor per 50 ft. radius of floor.
2. Central Controller

a. The control panel shall be NEMA 4X wall-mount type, and shall provide readout and alarm output capability for up to ninety-nine (99) remote sensors grouped in control zones. Each sensor shall be connected to the central controller via RS-485 digital communication. Transmitter shall be capable of outputting gas levels via 4-20mA output.
b. The control panel shall provide a scanning LCD display showing the sensor number and parts per million (ppm) level of the target gas. The control panel shall provide a RUN/CALIBRATE switch to allow the operator to take the system offline for the purpose of adjusting warning and alarm set point levels, adjusting the warning and alarm level delay controls and for performing calibration tests at the remote sensors.
c. Four (4) DPDT relays shall be provided in the base panel. Relays shall be configured to provide the following:

i. System ok.
ii. Warning.
iii. Alarm
iv. Sensor fail.

d. The control panel shall be provided with a BACnet MS/TP communication interface to

the DDC system.
e. The control panel shall include a built-in buzzer with silence pushbutton.
f. The control panel shall operate on 24 VAC or 24 VDC power.

3. Carbon Monoxide (CO) Sensor/Transmitter

a. Detection Range 0-100 ppm
b. Accuracy ±5%, full scale
c. Operating Temp -4° to 104°F
d. Operating Power 24 VAC or VDC
e. Communication RS-485

4. Nitrogen Dioxide (NO2) Sensor/Transmitter

a. Detection Range 0-10 ppm
b. Accuracy ±10%, full scale
c. Operating Temp -4° to 104°F
d. Operating Power 24 VAC or VDC
e. Communication RS-485

5. Gas Alarm Levels

	CO	NO2
Alarm A	25 ppm	1 ppm
Alarm B	100 ppm	2 ppm

6. Accessories

a. Horn and Strobe: A remote alarm horn and strobe shall be located within the room. The horn shall be reset via a local pushbutton in the room. The strobe shall be reset on reset of the alarm condition. The horn, strobe and reset switch shall be furnished, installed and wired by this section.
b. Calibration: The gas detection system manufacturer shall provide a calibration kit and test gas cylinders. Enough gas shall be provided to accomplish all start-up and training work.
c. Start-Up and Training Service: The gas detection system manufacturer shall provide the services of a technician onsite for purposes of fully verifying the proper installation of the system, testing and calibrating the system, and training the Owner's personnel on the proper maintenance of the system. A minimum of two (2) full days shall be allowed.

7. Gas detection system shall be MSA Z-Gard Series, or approved equal.

K. BTU Meter – 3" and larger

1. BTU meters shall be used to meter chilled and hot water energy usage. Refer to drawings for quantity and locations of meters.
2. BTU meter shall be single-channel type comprised of a BTU computer, flow sensors and temperature sensors. BTU meter shall be capable of providing the following values to the

BMS: Energy Total, Energy Rate, Flow Rate, Supply Temperature.

3. BTU Computer

    a. Power Supply 108-132 VAC @ 50/60 Hz
    b. Display White, backlit, 16-character, 8-line numeric LCD
    c. Outputs

        i. Three (3) pulse outputs for energy total or mode operation.
        ii. One (1) analog output, field selectable 4-20 mA or 0-10 V.
        iii. Digital Communication BACnet MS/TP or BACnet IP

4. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST* traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within +0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
5. Flow sensor shall be in accordance with "Flow Meter" as specified below.
6. BTU meter shall be Onicon System 10, or approved equal.

L. BTU Meter

1. BTU meters shall be used to meter chilled and condenser water energy usage. Refer to drawings for quantity and locations of meters.
2. BTU meter shall be single-channel type comprised of a BTU computer, flow sensors and temperature sensors. BTU meter shall be capable of providing the following values to the BMS: Energy Total, Energy Rate, Flow Rate, and Temperatures.
3. BTU Computer

    a. Power Supply 100-230 VAC
    b. Display Graphical color screen
    c. Enclosure Wall-mounted NEMA 12
    d. Digital Communication BACnet MS/TP or BACnet IP
    e. Inputs

        i. Analog 4-20 mA (flow meters and temperature sensors, 1 or 2 channel)
        ii. Frequency 0-20 KHz, 30V p-to-p (turbine meters, 1 or 2 channel)

    f. Outputs

        i. Two (2) relays
        ii. Two (2) analogs

4. Temperature Transmitter – Liquid Immersion

    a. Sensing element RTD, Type Pt100 DIN EN 60751, Class A
    b. Calibration Matched pair for BTU measurement application
    c. Temperature range 32°F to 122°F
    d. Output signal 4-20 mA, Loop-powered
    e. Accuracy ±(0.27°F + 0.002 * |°T-32| reading)
    f. Display 4-Digit LCD, 1/2" high
    g. Power supply 9-30 VDC
    h. Thermowell Stainless steel 316

5. Flow sensor shall be in accordance with "Flow Meter" as specified below.
6. BTU meter shall be Sitrans FEC920, or approved equal.

M. Ultrasonic Flow Meter – 3" and larger

1. Flow meter shall be clamp-on transit time ultrasonic flow meter complete with matched transducers, self-aligning installation hardware and coaxial transducer cables.
2. Flow meter shall be installed without making any openings in the pipe wall and shall utilize non-wetted ultrasonic transducers that may be located up to 300 ft from the meter. Ultrasonic transducers shall be optimized for the specific pipe & process conditions for each application and the transducer frequency shall be automatically matched to the resonant frequency of the pipe at start-up. An integral auto-zero function shall be provided for zero precision and high accuracy.
3. Flow meter shall meet the following criteria:

   a. Technology Ultrasonic
   b. Measurement Principle Transit-time difference correlation principle
   c. Accuracy ± 1% from 1 to 40 ft/s, ± 0.01 ft/s below 1 ft/s
   d. Turndown 400:1
   e. Outputs

      i. One (1) auxiliary pulsed output.
      ii. One (1) analog output, field selectable 4-20 mA or 0-10 V.

   f. Digital Communication BACnet MS/TP

4. Provide remote mounting of display at eye level for applications where flow sensor is located above 10 ft. For all other locations, transmitter shall be mounted to flow sensor assembly.
5. Flow meter shall be Onicon Model F-4200 or approved equal.

N. Ultrasonic Flow Meter – Up to 2-1/2"

1. Flow meter shall be inline complete with direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate.
2. Flow meter shall be installed without making any openings in the pipe wall. Ultrasonic transducers shall be optimized for the specific pipe & process conditions for each application and the transducer frequency shall be automatically matched to the resonant frequency of the pipe at start-up.
3. Flow meter shall meet the following criteria:

   a. Power Supply 20-28 VAC @ 50/60 Hz
   b. Technology Ultrasonic
   c. Measurement Principle Transit-time difference correlation principle
   d. Accuracy ± 1% over 25:1 turndown, ±2% over 100:1 turndown
   e. Overall Turndown 500:1
   f. Outputs

      i. One (1) auxiliary pulsed output.
      ii. One (1) analog output, field selectable 4-20 mA or 0-10 V.

   g. Digital Communication BACnet MS/TP

4. Flow meter shall be Onicon Model F-4600 or approved equal.

2.20 AUTOMATIC CONTROL VALVES

A. General

1. All control valves shall be electrically actuated and shall include a handle or wheel for manual override.
2. Unless otherwise indicated on the control diagrams or in the sequences of operation, valve fail positions shall be:

   a. AHU Preheat Coil Fail Open
   b. AHU Cooling Coil Fail Closed
   c. Reheat Coil Fail Closed
   d. Radiation Valves Fail Open
   e. Unit Heater Valves Fail Open
   f. Diff. Pressure Bypass Fail-In-Place
   g. Isolation Valve Fail Closed

3. Valves shall have sufficient stuffing box protection to ensure against leakage at hydrostatic head involved. Control valve operators shall be sized to close against differential pressure equal to the design pump head plus 10 percent. Valve leakage shall meet or exceed ANSI Class IV leakage (0.01% of rated valve capacity).
4. Valve actuators shall be factory installed on valve bodies. Field installation of actuators is not acceptable.

B. Two-way Pressure-Independent Modulating Control Valves – Up to 2″

1. Automatic control valves shall be pressure-independent type. Valves shall be suitable for chilled and hot water systems. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of power failure. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controllers and variable load requirements. The valves shall be capable of operating in sequence with other valves and/or dampers when required by the sequence of operation. All control valves shall be sized by the control manufacturer and shall be guaranteed to meet the heating and cooling loads as scheduled. All control valves shall be suitable for the pressure conditions and shall close against the differential pressures involved. All valve operators shall be either spring-return electrically actuated type or electronic fail-safe type. Body pressure rating and connection-type construction shall conform to fitting and valve schedules, as per the Heating, Ventilating and Air Conditioning Section of the specifications.
2. Performance:

   a. Pressure Rating 360 psig
   b. Close-off pressure Suitable for application
   c. Temperature Range 36 to 212°F

3. Control valves shall meet the following material construction specifications:

   a. Body Forged brass.
   b. End Connection NPT female
   c. Ball Stainless steel

d. Stem Stainless steel
e. Ball Seats Teflon PTFE
f. Stem Seal EPDM O-rings
g. Flow Characteristic Equal percentage

4. The maximum differential pressure across valve shall be 5 to 50 psid.
5. Input power voltage shall be 24VAC.
6. Control signal to valves shall be via hardwired analog output (2-10VDC). Position feedback shall be via hardwired analog input (2-10VDC).
7. Valves shall be Belimo Model PIQCV, Siemens PICV, or approved equal.

C. Two-way Pressure-Independent Modulating Control Valves – 2-1/2" and larger

1. Automatic control valves shall be pressure-independent type. Valves shall be suitable for chilled and hot water systems. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of power failure. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controllers and variable load requirements. The valves shall be capable of operating in sequence with other valves and/or dampers when required by the sequence of operation. All control valves shall be sized by the control manufacturer and shall be guaranteed to meet the heating and cooling loads as scheduled. All control valves shall be suitable for the pressure conditions and shall close against the differential pressures involved. All valve operators shall be either spring-return electrically actuated type or electronic fail-safe type. Body pressure rating and connection-type construction shall conform to fitting and valve schedules, as per the Heating, Ventilating and Air Conditioning Section of the specifications.
2. Control valve shall integrate three functions into a single device: control valve, adjustable flow limiter, and automatic pressure regulator.
3. Performance:

a. Pressure Rating ANSI 125, ANSI 250
b. Close-off pressure 100 psi
c. Temperature Range 34 to 250°F

4. Control valves shall meet the following material construction specifications.

a. Body Cast iron
b. End Connection Flange pattern to mate with ANSI 125/250
c. Plug Brass
d. Seat Stainless steel
e. Stem Stainless steel
f. Flow Characteristic Linear

5. The maximum differential pressure across valve shall be 5 to 50 psid.
6. Input power voltage shall be 24VAC.
7. Control signal to valves shall be via hardwired analog output (2-10VDC). Position feedback shall be via hardwired analog input (2-10VDC).
8. Valves shall be Siemens Two-Way Flanged PICV or approved equal.

D. Motorized Isolation Valves – Up to 2"

1. A valve shall be suitable for chilled and hot water service. The isolation valve shall be

line-sized, full-port ball valve.

2. Performance:

   a. Pressure Rating 360 psig
   b. Close-off pressure 200 psi
   c. Temperature Range 35 to 250°F

3. Valves shall meet the following material construction specifications:

   a. Body Forged brass
   b. End Connection NPT female
   c. Ball Stainless steel
   d. Stem Stainless steel
   e. Ball Seats Teflon PTFE
   f. Stem Seal EPDM O-rings

4. Input power voltage shall be 24VAC.
5. Valves shall be two-position (on/off) and provided with open and closed end switches.
6. Valves shall be manufactured by Belimo, Siemens, or approved equal.

E. High Performance Motorized Butterfly Valves for Isolation – 2-1/2" and larger

1. A valve shall be suitable for chilled and hot water service. The valve shall be line sized.
2. Performance:

   a. Pressure Rating ANSI Class 200, 740 psig
   b. Close-off pressure Suitable for application
   c. Temperature Range -62 to 500°F

3. Valves shall meet the following material construction specifications:

   a. Body Carbon steel
   b. End Connection Lugged
   c. Disc Stainless steel
   d. Stem Stainless steel
   e. Seat PTFE

4. Valve Actuator

   a. Input Power 120 VAC or 24 VAC
   b. Signal Two position (on/off)
   c. Enclosure Rating NEMA 4 or greater
   d. Limit Switches Integral opened and closed
   e. Torque Suitable for application close-off
   f. Manual Override Handwheel

5. Valve and actuator shall be as manufactured by Siemens, Bray, or approved equal.

2.21 DAMPER ACTUATORS

A. Automatic control dampers, smoke dampers, and fire smoke dampers shall be furnished under the Mechanical Section of the specifications.

B. This section of the specification shall be responsible for furnishing and installing electrical spring-return actuators for all automatic louvered dampers (non-fire and/or smoke-rated dampers). Smoke dampers and combination smoke/fire dampers shall be factory-furnished with electric actuators as part of their UL assemblies.
C. All electrical wiring (power) for smoke dampers (SDs) and combination fire/smoke dampers (FSDs) shall be furnished and installed by the Electrical contractor at a junction box located at each combination damper. Control wiring shall be by this section.
D. All electrical wiring (power and control) for all automatic louvered dampers (ALDs) shall be furnished and installed by this section. ALD actuators shall be 24 VAC.
E. Damper Actuators

1. All automatic louvered damper operators in two-position (open/closed) and modulating (0-10VDC) service shall be 24 or 120 VAC electrically actuated spring-return type. Spring-return running time shall not exceed 20 seconds. Power running time shall not exceed 20 seconds.
2. Smoke dampers and combination fire/smoke damper operators shall be provided with integral 120 VAC actuators as part of their UL-listing
3. Automatic louvered damper operators shall be provided with manual override and external direction of rotation switch and shall be quiet in operation.
4. Operating temperature shall be -22°F to 122°F. Housing shall be NEMA 2.
5. Actuators shall be UL-listed.

F. Provide a sufficient number of damper actuators to operate single and multiple damper sections smoothly and in unison at the maximum rated static pressure and air velocity, and to provide the close-off torque required to meet damper leakage criteria. Provide auxiliary drive shafts with pillow block bearings and bearing support brackets rigidly attached to the damper frame assembly on damper banks more than one (1) damper section wide.
G. Actuators shall be installed outside of airstream.
H. Damper actuators located outdoors shall be equipped with weatherproof enclosure containing O-ring gaskets designed to make motors weatherproof and an internal heater to permit normal operation at minus 22ºF.
I. Damper actuators shall be manufactured by Belimo, Siemens, or approved equal.

PART 3 - EXECUTION

3.1 ELECTRICAL WIRING

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes".
B. Install building wire and cable according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables".
C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling"
D. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
E. Install exposed cable in EMT raceways.
F. Install concealed cable in EMT raceways.
G. Install outdoor cabling in galvanized rigid conduit.
H. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
I. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

J. Number-code or color-code conductors for future identification and service of control system, except local individual room control cable.
K. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
L. Plenum Rated Cable to be used in accessible locations above ceilings (i.e. open ceilings and drop-ceilings).
M. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories.

1. Provide wiring for thermostats, aquastats, and all control and alarm devices for all Sections of the Specifications and wiring for all break-glass stations furnished under this Section.
2. Power for each direct digital control unit, field equipment panel, workstation, server, controller, shall be taken from dedicated power circuits as indicated on the electrical drawings. Power type (normal, emergency, life-safety, etc.) shall match that of the associated mechanical equipment. Wiring and conduit between the electrical junction boxes and all direct digital control units, field equipment cabinets, workstation, server and unitary controllers, etc., shall be furnished and installed by this Section of the Specifications. In addition, this Contractor shall provide a 120 volt, 60 hertz convenience outlet in each controller and panel. Refer to Electrical Drawings for distribution panel locations.
3. Provide conduit and control wiring for devices specified in this Section.
4. Provide control and signal wiring between the DDC system and equipment provided by other Sections such as pumps, variable frequency drives, etc.
5. Provide all control wiring for variable air volume and constant air volume terminal units.

N. All systems requiring interlock wiring shall be hardwired interlocked and shall not rely on the DDC system to operate (e.g., emergency generator to fuel oil pump interlock, emergency generator damper interlock, etc.). Interlock wiring shall be run in separate conduits from DDC system associated wiring.
O. All wiring in Mechanical Equipment Rooms, communications or electrical closets shall be in approved raceways (cable tray, conduit, EMT, etc.). Open wiring strung above accessible ceilings shall be plenum-rated cable, bundled together and protected from mechanical damage. Wiring within inaccessible ceilings shall be installed in conduit. Wiring within drywall cavities or enclosures or beneath raised floor construction shall be in conduit. Wiring shall be independently supported from the building structure with bridal rings and clips. The supporting of wiring from mechanical ductwork or piping shall not be acceptable. Provide individual support for conduit. Where conduit is required, this Contractor shall be responsible for providing all conduit serving DDC system. DDC system wiring (i.e. power, control, communication, sensor or interlock) shall not be installed in conduits provided under another section of the specification unless noted otherwise. DDC system wiring shall not "share" conduits with any other system unless noted otherwise.
P. Cables for 120/24 VAC wiring, communications wiring and low-level signal wiring (i.e., 4 - 20 mA analog) shall always be run in separate raceways.
Q. Low-level signal wiring home runs to local control stations may be by means of multi-pair cables. The number of pairs in such cables shall be uniform throughout the installation, and, in general, there shall be at least 20% spare pairs in each such cable.
R. 120 VAC circuits used for control and instrumentation shall be taken from panelboards provided under the Electrical Section. The electrical section shall provide junction boxes local to the BMS devices and equipment. Final connection between junction box and BMS devices shall be furnished by this Contractor.
S. 120 VAC circuits used for control and instrumentation shall be dedicated to the ATC system

and shall not be used for any other purposes.

T. RS-485 Cabling

1. RS-485 cabling shall be used for BACnet MS/TP networks.
2. RS-485 shall use low capacitance, 20-24 gauge, twisted shielded pair.
3. The shields shall be tied together at each device.
4. The shield shall be grounded at one end only and capped at the other end.
5. Provide end of line (EOL) termination devices at each end of the RS-485 network or subnetwork run, to match the impedance of the cable, 100 to 120 Ohm.

U. Ethernet Cabling

1. Ethernet shall not be run with any Class 1 or low voltage Class 2 wiring.
2. CAT6, unshielded twisted pair (UTP) cable shall be used for BAS Ethernet.
3. Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room up to 50 feet away.
4. When the BAS Ethernet connects to an Owner's network switch, document the port number on the BAS As-builts.

V. Fiber-Optic Cabling

1. All fiber optic cabling shall be 50/125-micrometer, laser-optimized (multi-mode OM3/OM4), duplex (2-strand) fiber, optical fiber cable with plenum-rated jackets. Minimum bend radius shall be 7.5mm. Industry standard LC style connectors shall be usedFiber optic cabling shall be manufactured by Corning.
2. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.
3. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.
4. All terminations shall be made into a patch panel, designed for such use. Free air terminations with patch panels are prohibited.

W. Control raceways shall not be hung from electrical raceways or attached to ceiling grid hanger wires.

X. Percent fill of conduit, EMT or IMC shall not exceed code maximum, regardless of service.

3.2 IDENTIFICATION

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels should read as follows: CAUTION This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels shall read as follows: CAUTION This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

C. Control Equipment and Device labeling:

1. Labels and tags shall match the unique identifiers shown on the as-built drawings.
2. All Enclosures shall be labeled to match the as-built drawing by either control panel name or the names of the DDC controllers inside.
3. All sensors and actuators not in occupied areas shall be tagged.
4. Airflow measurement arrays shall be tagged to show flow rate range for signal output range, duct size, and pitot tube AFMS flow coefficient.
5. Duct static pressure taps shall be tagged at the location of the pressure tap.
6. Each device inside enclosures shall be tagged.
7. Terminal equipment needs only have a tag for the unique terminal number, not for each device. Match the unique number on:

    a. First, the design drawings, or
    b. Second, the control as-builts, or
    c. Third, the DDC addressing scheme.

8. Tags on the terminal units shall be displayed on the Operator Workstation Graphics.

D. Tags shall be mechanically printed on permanent adhesive backed labeling strips, 12-point height minimum.
E. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
F. Identification of Wires

1. Tag each wire with a common identifier on each end of the wire, such as in the control panel and at the device termination.
2. Tag each network wire with a common identifier on each end.
3. Tag each 120V power source with the panel and breaker number it is fed by.

G. Identification of Conduits:

1. Identify the low voltage conduit runs as BAS conduit, power feeds not included.
2. Identify each electric box, junction box, utility box and wiring tray with a blue paint mark or blue permanent adhesive sticker.
3. For conduit runs that run more than 8 ft between junction boxes in 1 room, place a blue identifier at least every 8 feet.
4. Place a blue identifier on each side of where a conduit passed through a wall or other inaccessible path.
5. Identify all BAS communication conduits the same as above.

3.3 GRAPHIC DISPLAY GENERATION

A. All workstation(s) shall be provided with color graphics. All workstation(s) software shall include graphical viewing and control environment and definition and construction of dynamic color graphic displays.
B. Provide a main default screen showing the Basic layout of the building. Each color graphic screen shall have transfer links to allow the building operator to transfer between system

associated screens (both forward and backward), as well as a transfer link back to the main default screen.

C. Graphic Structure: The intent of the graphics is to ensure the operator is always aware of his position within the system and how to logically and intuitively progress through the graphical hierarchy to select desired graphic or other source of information. Provide the operator with the capability of returning to a previous graphic by pointing to a graphic tab then pushing a single button. Program the system to provide a separate color graphic for each piece of equipment monitored or controlled including:

1. Each floor and zone controlled.
2. Each equipment unit and terminal
3. Each schedule
4. Each trend
5. Each report
6. Each Graphical Software Program

D. File formats for floor plans shall consist of svg or png. Floor plans shall show the location of each space temperature sensor with a dashed line to the associated terminal unit. Display in real time the difference between the space temperature and the current setpoint.

1. Display the cooling %, heating % (if applicable) and current airflow of each terminal unit.
2. Provide a transfer link for each terminal unit to allow the operator to access the flow graphic for each individual terminal unit. Use a different color to shade the background area for each part of a floor plan graphic served by a different air handling unit.

E. All control set points shall be easily adjustable from the system's color graphic screen by operators with the proper access level. Each controlled point on the BMS operator workstation color graphic screens shall have the set point indicated along with the actual controlled variable reading (preferred set point on top and actual reading on bottom). All points shall indicate the associated engineering unit. All analog output points shall indicate engineering units such as "%-open" or "%-closed" as required by the application. All normally-closed or normally-open points shall indicate the normal position (such as "N.C." or "N.O." next to the controlled device).

F. Provide system color graphics for each HVAC system and for each electrical, plumbing and/or piping system that is monitored and/or controlled by the BMS. Provide scaled floor plans indicating equipment location, service, and system data as required.

G. Provide color graphic floor plan displays and system schematics for each piece of mechanical equipment, including but not limited to air handling units, chilled water systems and hot water systems to optimize system performance analysis and speed alarm recognition.

H. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

I. The windowing environment of the PC operator workstation(s) shall allow the user to simultaneously view several graphics at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

1. Graphic generation software shall be provided to allow the user to add, modify or delete system graphic displays via an embedded graphics package.
2. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols.

3. Graphical displays can be created to represent any logical grouping of system points or calculated data Based upon building function, mechanical system, building layout or any other logical grouping of points which aids the operator in the analysis of the facility.

J. Provide an automatically updated, dynamic display of the site-specific BMS architecture indicating the status of primary and secondary controllers, PC workstation(s)and networks.
K. Provide a separate dynamic display page of each HVAC (AHU air handling systems, AC, chiller, cooling tower, fuel oil, etc.), electrical, and/or plumbing system connected to the BMS.
L. Provide a separate dynamic display page of each piece of terminal equipment (VAV box, fan coil unit, etc.) connected to the BMS.
M. Graphics shall incorporate all system integration points communicated via hardware or software gateways and/or interfaces. The origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.
N. Each graphic shall have a "BACK" button and a "HOME" or "MAIN" button located in the same location on all graphics.
O. The operator shall be able to clearly distinguish the difference between the following types of points on a graphic either by color, shape, icon or text label:

1. Real-time sensor reading
2. Setpoint
3. Manually set vs. program set Setpoint.
4. Real-time output reading
5. Manually Overridden or commanded output vs program set output.
6. Status feedback from a piece of equipment vs the output command

P. When the operator selects a graphic from a menu or a hyperlink, the system shall also make the following adjustments for the operator:

1. Highlight the system name on the system tree.
2. Highlight the controller's name on the network tree.
3. Make appear links to additional information associated with the data on the graphic, such as:

a. Adjustable modes of operation
b. Setpoints
c. Alarm statuses
d. Trend logs

Q. Make appear links to additional information associated with the system on the graphic, such as:

1. Controls as-built schematics and wiring diagrams
2. As-built Sequence of Operation
3. Mechanical drawings
4. Electrical drawings

R. For control loops that have a 4-point setpoint reset schedule, the operator shall have access to adjust the 4 points in the graphics. Provide a separate graphic with the 4 adjustable data points and a line graph with labels vertices showing the scale of the reset ramp. Display the current calculated output setpoint.

S. Integration graphics shall be representative of personnel standing in front of equipment. The graphics for equipment specified in the Building Systems Integration paragraph shall be representative of the manufacturers' local display panel and each shall be completely operable from the computer workstation.

3.4 FIELD QUALITY CONTROL

A. After completion of the installation of work in this section, test, regulate and adjust system equipment, controllers, alarms, sensors, transmitters, switches, relays, automatic control valves, automatic damper motors and related system accessories, and the entire automation system, including interconnections with the building life safety, plumbing, fire protection and electrical systems, and place these items in complete and satisfactory operating condition. Submit data showing set points and final adjustments of controls.
B. This Contractor shall provide assistance to the Air and Water Balancer for access to all set point adjustments and calibration requirements. At the completion of the balancing process all air and water set points shall be hardcoded into the default set points for each system.

3.5 SYSTEM ACCEPTANCE TESTING

A. Prior to full operation, the contractor in the presence of the owner's representative engineer shall perform a complete demonstration and testing of the system operating functions and alarms. This testing shall take place after having satisfactorily met the requirements of shop drawing acceptance. Upon successful completion of system operation, the contractor shall submit a statement in writing stating that the full operation of all systems, functions and alarms has been demonstrated and are operational as well as a listing of all systems, alarms and functions that have been commissioned. All items shall be submitted for review and acceptance to the owner, owner's representative and engineer before final acceptance can take place.
B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Closeout Procedures" and "Demonstration and Training."

3.6 COMMISSIONING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instruments and controls. Refer to Division 1 Section "Demonstration and Training".
B. The BMS contractor shall submit point to point calibration documentation for all points and functional testing documentation for all control loops showing all control systems have been tested, start-up complete, final PID adjustments complete, dynamic graphics installed on workstation as per owner's requirements etc. prior to scheduled demonstration and commissioning.
C. The BMS contractor shall notify the owner's authorized representative that the BMS is 100% ready for demonstration and commissioning. The BMS contractor shall demonstrate to the authorized representative typical operating functional control loops for 50% of control points and functions.

3.7 TRAINING

A. Provide sixteen (16) hours of on-site training for four (4) building operators from competent factory authorized personnel. Intent is to provide instruction to operation and maintenance personnel concerning the location, operation and troubleshooting of the installed systems.

The instruction shall be scheduled in coordination with the Construction Manager and owner after submission and approval of formal training plans. All training sessions shall be recorded by the BMS contractor and submitted as part of the operations and maintenance documentation.

B. Training shall include but not limited to:

1. Explanation of drawings and operations and maintenance manuals.
2. Walk thru of the job to locate control components.
3. Operator workstation and peripherals.
4. Operator control functions including graphic generation and field panel programming.
5. Explanation of adjustment, calibration and replacement procedures.

END OF SECTION

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Service meters.
7. Dielectric fittings.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Piping specialties.
2. Corrugated, stainless steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Certificates:

1. Welding certificates.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For professional engineer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. Pipe Welding: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:

1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without [Architect's] [Construction Manager's] [Owner's] written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with [NFPA 54] [the International Fuel Gas Code].

B. Minimum Operating-Pressure Ratings:

1. Piping and Valves: [100 psig (690 kPa)] minimum unless otherwise indicated.
2. Service Regulators: [100 psig (690 kPa)] minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: [5 psig (34.5 kPa)]

C. Natural-Gas System Pressure within Buildings:

1. Single Pressure: [0.5 psig (3.45 kPa) or less]

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. Seismic Performance: Natural-gas piping system is to withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7] <Insert requirement>. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1. The term "withstand" means "the piping system will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the piping system will be fully operational after the seismic event]."
2. Component Importance Factor: [1.5] [1.0].
3. <Insert requirements for Component Amplification Factor and Component Response Modification Factor>.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:
    a. Steel flanges and tube with epoxy finish.
    b. NBR seals.
    c. Stainless steel bolts, washers, and nuts.
    d. Coupling is to be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    e. Steel body couplings installed underground on plastic pipe are to be factory equipped with anode.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated, stainless steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.

7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm).

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Seals: Nitrile.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Weatherproof Vent Cap:

1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: [125 psig (862 kPa)].
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
4. Service Mark: Initials "WOG" permanently marked on valve body.

C. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural gas.
5. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig (862 kPa).

8. Listing: Valves NPS 1 (DN 25) and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Valve Boxes:
1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Flanged for regulators NPS 4 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80A.
1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: UV-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
8. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 2 psig (13.8 kPa)

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: NBR.
5. Seal Plug: UV-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 1 psig (6.9 kPa

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: [125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)] <Insert pressure>.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: [125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [175 psig (1200 kPa)] [300 psig (2070 kPa)] <Insert pressure>.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: [150 psig (1035 kPa)] <Insert pressure>.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

B. Label and identify gas piping and pressure outside a multitenant building by tenant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping in accordance with NFPA 54 and the NYS Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the NYS Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

A. Comply with NFPA 54 and the NYS Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least [36 inches (900 mm)] below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping in accordance with ASTM D2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

3.4 INSTALLATION OF INDOOR PIPING

A. Comply with NFPA 54 and the NYS Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.

E. 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.

F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.

G. Locate valves for easy access. Do not locate valves within return air plenums.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
2. Install sediment trap on both sides of regulators for gas reduction to 2 psig (13.8 kPa) with valve and capped.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gauge downstream from each line regulator. Pressure gauges are specified in Section 230519 "Meters and Gauges for HVAC Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "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 Section 230517 "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 Section 230518 "Escutcheons for HVAC Piping."

3.5 INSTALLATION OF SERVICE-METER ASSEMBLIES

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 INSTALLATION OF VALVES

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Do not install valves in return-air plenums.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.

3.8 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches (300 mm) of each fitting.

F. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.9 PIPING CONNECTIONS

A. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.

B. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.10 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base[.][in accordance with seismic codes at Project. See Section 230548 "Vibration and Seismic Controls for HVAC."]

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

2. 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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use [3000 psig (20.7 MPa)] 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.12 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with [NFPA 54] [the International Fuel Gas Code] and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.13 PIPING SCHEDULE

A. Underground natural-gas piping is to be the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
2. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   a. Fittings: ASTM A234/A234M forged steel welding type.
   b. Joints: ASME B31.9, welded.

B. Aboveground natural-gas piping is to be[one of] the following:

1. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   a. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
   b. Joints: Threaded for pipe 2 inches and smaller; welded for pipe 2-1/2 inches and larger.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, distribution piping NSP 4 and smaller is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping NSP 5 and larger is to be one of the following:
1. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping is to be one of the following:
1. Steel pipe with wrought-steel fittings and welded joints.
2. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
3. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.15 UNDERGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:
1. NPS 2-1/2 (DN 65) and Larger: Cast-iron, [lubricated] plug valves.

3.16 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller are to be[one of] the following:
   1. Two-piece, [full]-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger are to be[one of] the following:

   1. Two-piece, [full]-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, [lubricated] plug valve.

C. Valves in branch piping for single appliance are to be one of the following:
   1. Two-piece, [full] -port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

END OF SECTION 231123

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.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Plastic pipe and fittings.
4. Joining materials.
5. Transition fittings.
6. Dielectric fittings.

1.3 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe.
2. Fittings.
3. Joining materials.

B. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 200 deg F.
2. Chilled-Water Piping: 150 psig at 73 deg F.
3. Glycol Cooling-Water Piping: 150 psig at 150 deg F.
4. Makeup-Water Piping: 80 psig at 73 deg F.
5. Condensate-Drain Piping: 180 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.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Drawn-Temper Copper Tubing: ASTM B 88, Type M.

C. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

D. 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; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

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.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 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 otherwise 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.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. 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.

G. Solvent Cements for CPVC Piping: ASTM F 493.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. KBI (King Bros. Industries).
d. Viega LLC.

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. KBI (King Bros. Industries).
d. NIBCO INC.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. 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. Jomar International Ltd.
e. Matco-Norca, Inc.
f. McDonald, A. Y. Mfg. Co.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. 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:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating 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. Description:

a. Nonconducting 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 Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elster Perfection.
    b. Grinnell Mechanical Products.
    c. Matco-Norca, Inc.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.

2. Description:

    a. Standard: IAPMO PS 66.
    b. Electroplated steel nipple, complying with ASTM F 1545.
    c. Pressure Rating: 300 psig at 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Glycol cooling-water piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Glycol cooling-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

G. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered.

H. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

I. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, 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 piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. 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.

P. Install valves according to the following:

1. Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 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 nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

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.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

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 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: 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.

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. 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 pipe and fittings before assembly.

C. 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.

D. 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/A5.8M.

E. 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.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.6 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.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 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 the 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 the "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.
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.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC 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 special-duty valves and specialties for the following:

1. Hydronic specialty valves.
2. Air-control devices.
3. Strainers.
4. Connectors.
5. Glycol feeder.

B. Related Requirements:

1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
2. Section 230523 "General-Duty Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
3. Section 230900 "HVAC Instrumentation and Control" for automatic control valve and sensor specifications, installation requirements, and locations.

1.3 SUBMITTALS

A. Product Data: For each type of the following:

1. Hydronic Specialty Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Strainers.
4. Connectors.
5. Glycol feeder.

B. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

C. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. 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 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.
    c. HCI; Hydronics Components Inc.
    d. Taco, Inc.
    e. Victaulic Company.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.
11. Size: 2” and smaller.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.
    c. HCI; Hydronics Components Inc.
    d. Taco, Inc.
    e. Victaulic Company.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.
12. Size: 2-1/2" and larger.

C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Apollo Valves; Conbraco Industries, Inc.
    c. Armstrong Pumps, Inc.
    d. Bell & Gossett; a Xylem brand.
    e. Spence Engineering Company, Inc.
    f. Watts; a Watts Water Technologies company.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Apollo Valves; Conbraco Industries, Inc.
    c. Armstrong Pumps, Inc.
    d. Bell & Gossett; a Xylem brand.
    e. Spence Engineering Company, Inc.
    f. Watts; a Watts Water Technologies company.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flowcon Americas LLC.
    b. HCI; Hydronics Components Inc.
    c. NuTech Hydronic Specialty Products.
    d. Oventrop Corporation.
    e. Turnstall Corporation.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 300 psig.
9. Maximum Operating Temperature: 250 deg F.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.
    d. NuTech Hydronic Specialty Products.
    e. Taco, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.

b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.
d. NuTech Hydronic Specialty Products.
e. Taco, Inc.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Diaphragm-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Grundfos
b. Paco, Inc.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Grundfos
b. Paco, Inc.

2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

E. Hydronic Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Grundfos

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

2.4 CONNECTORS

A. 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.

B. 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.

2.5 GLYCOL FEEDER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grundfos (Basis-of-Design)
2. Advantage Controls
3. J.L. Wingert Company

B. Propylene Glycol Feeder: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

1. Pump – Provide (2) pumps. The pump shall be a bronze rotary gear pump with a capacity of 1.8 g.p.m. at a pressure of 100 p.s.i. Pump shall be mounted below the tank.
2. Tank – The tank shall be constructed of polyethylene and be provided with a four-leg carbon steel stand with four bolt pads. The tank stand shall have upper and lower steel support banding to insure tank stability. Tank stand shall be painted with a two-coat system consisting of an oxide primer and alkyd enamel finish.
3. Piping – Pump suction piping shall be piped using PVC fittings and tubing. A PVC ball valve and a cast iron "Y" strainer shall be provided in the pump suction piping. Pump discharge manifold shall be piped using Schedule 40 brass fittings suitable for chilled service. A pressure switch, ball valve, brass check valve and brass relief valve shall be

mounted on the pump discharge assembly manifold. Piping shall be supported at both the top and bottom of the tank frame. The brass relief valve shall be piped back to the tank using PVC tubing and fittings. A pressure gauge shall be mounted in the discharge piping.

4. Panel – A 115 volt control panel with NEMA 4X enclosure consisting of the following shall be provided:

    a. H-O-A selector switch with running light and magnetic starter for feed pump. In AUTO, the pump is operated by the skid-mounted differential (adjustable) pressure switch and interlocked to a low level float switch mounted in the side of the tank. Level switch also energizes a low level audible alarm with silence push button for alarm acknowledgement. Panel shall also be equipped with an 8' power cord with grounded plug. Panel shall be mounted to the tank frame and positioned at eye level for ease of operation. Panels mounted on tank lids or mounted below the tank are unacceptable. All electrical components (pressure switch, level switch, and pump) shall be wired in conduit to control panel. Loose, exposed, unprotected wire is unacceptable.

5. Provide High level alarm.
6. Provide Protective skirt.

PART 3 - EXECUTION

3.1 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 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.

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; 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.

3.2 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 piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

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.

1.2 SUMMARY

A. Section Includes:

1. Wet Rotor Circulator with speed switch
2. End Suction Split Coupled Pumps with Integral Variable Frequency Drive

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Product Data: For each type of pump. 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.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 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 pump.

PART 2 - PRODUCTS

2.1 WET ROTOR CIRCULATOR WITH SPEED SWITCH

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Grundfos Pumps Corporation (Basis-of-Design)
2. Paco Pumps

B. Installation references: The wet runner pump manufacturer shall have a minimum of 10 years of experience in the country of the installation. The contractor shall provide a minimum of 5 installation references of similar size in the state/province pump is going to be installed.

C. General Requirement:

1. Furnish and install 3 speed 3x60x208-230V circulator pumps as per plans and pump schedule.
2. The pump shall be a standard product of a single pump manufacturer. The pump and motor shall be designed and built by the same manufacturer.
3. The wet rotor circulator pump shall be certified and listed by UL (1Z28 Water circulating pump) and/or CSA (Water Circulating Pump) for conformance to U.S. and Canadian Standards to operate at maximum 248ºF and minimum 14ºF water.
4. The maximum noise level of the pump and motor shall be 41dB(A)Pump Bearings: Permanently lubricated ball bearings.
5. The pumps shall be capable of operating continuously at 248ºF.

D. Pumps

1. The pumps shall be of the quiet wet rotor in-line design.
2. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region.
3. The pumps shall have the following features:
   a. The pump housing shall have a stainless steel neck ring to minimize recirculation and increase pump efficiency.
   b. The impellers shall be laser welded stainless to obtain maximum efficiency. Composite material shall not be acceptable. The impellers shall be secured to the shaft with a neck ring and a nut.
   c. The suction and discharge flanges shall be tapped and drilled to allow gauge installation on the pump.
   d. All 3 speed pumps shall have fiber optic indicator lights for operation indication and trouble shooting.
   e. The pumps shall have tungsten carbide sleeve bearings for extended life. Metal impregnated carbons bearings shall not be acceptable.
   f. Pump Construction.

a.	Pump housing:	Cast iron EN-JL-1040 (A 48 Cl 40B)
b.	Impellers, rotor can, rotor cladding,:	304 Stainless Steel
c.	Shaft	303 Stainless Steel
d.	Bearings:	Tungsten Carbide
e.	Shaft journals/ inner bearings:	Silicon Carbide
f.	O-rings:	EPDM

g. Bearing plate: 304 Stainless Steel

E. Integrated Motors

A. Each motor shall be of the asynchronous squirrel cage design and tested with the pump as one unit by the same manufacturer.
B. The stator housing shall be made of pressure die cast aluminum. The stator housing shall have 8 drain holes to enable condensed water to escape.
C. The motor shall be cooled by the pumped fluid.
D. Motor shall be self-ventilating. The stator housing shall have nickel plated brass inspection screw.
E. Minimum insulation class for the motors shall be Class F.

F. Terminal Box

A. The terminal box shall be made of black composite material. Enclosure class shall be IP44.Aluminum terminal boxes shall not be acceptable.

B. The terminal box shall be suitable to accept add-on modules.

C. Each pump shall be supplied with relay module for duty standby pump application (2 pumps only). The relay module shall be capable of rotating the pumps every 24 hours. Relay module shall provide protection against overheating at all speed.

D. Each pump shall be supplied with relay module to provide external fault signal. Relay module shall provide protection against overheating at all speed.

E. Each pump shall be supplied with protection module for direct connection to mains.

F. The pumps shall be provided with standard module (3x60X230V) or terminal box (3x60x460V or 3x60x575V).

2.2 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Grundfos Pumps Corporation (Basis-of-Design)
2. Paco

B. General:
1. Contractor shall furnish and install Grundfos end suction split coupled pump, Grundfos Model NBS complete with pump, motor, and coupling in accordance with manufacturer's recommendations and plans.
2. Pump unit shall have machined registered fits between volute, motor bracket and motor. No factory or field alignment shall be required on this pump unit.
3. The coupling design shall permit replacement of the mechanical seal without requiring removal of the impeller, system piping, pump volute or drive motor.

C. Pump Construction:

I. The pumps shall be split coupled, single stage, end suction top discharge design, cast iron stainless steel fitted construction. Pumps up to 6" discharge shall be centerline discharge, 8" and 10" discharge shall be tangential discharge.

II. The pumps shall have the following features:

1. Seal replacement shall be possible by only removing the coupling and seal cap.

2. Pump shall not require a baseplate or grouting to maintain correct alignment and maintain vibration levels to Hydraulic Institute standards (HI 9.6.4).

3. All pumps shall be of the back pull-out design so that the rotating element can be removed from the casing without disconnecting the suction or discharge piping. Motors shall pull back without requiring lifting.

4. The casing material shall be close-grained cast iron ASTM A48 - Class 35 with a minimum tensile strength of 35,000 P.S.I.

5. Volute shall have integrally cast suction and discharge ports, vent and drain ports. Pump volute shall have and integrally cast diffuser vane to provide balanced flow to the eye of the impeller reducing axial forces and improving efficiency. Casings shall be designed for scheduled working pressure and can withstand hydrostatic test at 150% of the maximum working pressure under which the pump could operate at design speed.

~~6.~~ Suction and discharge flanges shall be flat-faced and be drilled to ANSI Class 125 standards.

7. Pump shall be constructed such that grouting and field alignment are not required and that proper alignment tolerances are continuously maintained throughout the lifetime of the pump.

8. Pump volutes shall have an integrally cast foot to eliminate deflections and distortions.

9. The pump shaft shall be of solid stainless steel AISI 420.

10. The mechanical seal shall have as standard Silicon Carbide – Silicon Carbide rotating and stationary faces with EPDM elastomers. The silicon carbide shall be of the advanced type having optimized hydrodynamic properties for long life and emergency dry running. The pump manufacturer shall recommend the proper mechanical seal based on the pressure, temperature and liquid outlined on the equipment schedule. On request, application of a mechanical seal shall be internally flushed type, without requiring external flushing lines. Seals shall be capable of being inspected and easily replaced without removing the piping or volute.

11. [OPTIONAL]: Recirculation line of copper tubing with brass fitting (optional nylon or stainless) shall be provided to vent the mechanical seal.

12. Impeller shall be of the enclosed single suction design, made of Stainless Steel 304 (UNS S30400), dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft.

13. Pump Construction. The standard material of construction for the pump shall be as below. Special material shall be available as an option to suit the liquid pumped.

    - Volute: Cast iron ASTM A48 - Class 35
    - Impeller: Stainless Steel 304 (UNS S30400)
    - Shaft: Stainless Steel AISI 420
    - Coupling: Ductile Iron (ASTM 70-50-05)
    - Motor Support Rails: Carbon Steel (ASTM A36)
    - Mechanical Seal: Silicon Carbide – Silicon Carbide, EPDM Elastomers and Stainless-Steel hardware
    - [OPTIONAL] Recirculation Line: Copper Tubing with Brass Fittings

III. Pump rotating assembly shall be connected to the drive motor by a rigid, ductile iron, axially split coupling capable of maintaining alignment under all torsional, radial and axial loads. The coupling design shall facilitate alignment of the motor and pump shaft.
IV. The motor support rails shall be structural steel. The entire unit shall not require grouting for operation within Hydraulic Institute Standards for Vibration.
V. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.
VI. Each pump shall be painted with one coat of high-quality factory approved paint and name-plated before shipment from the factory.
VII. Pumps shall be manufactured and assembled in an ISO-14001 and ISO-9001 certified facility.

D. Integrated Variable Frequency Drive Motors:

I. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) with a built-in pump system controller. The complete VFD/motor assembly shall be built and tested as one unit by the same manufacturer.
II. The VFD/motor shall have an IP55 (TEFC) enclosure rating as a complete assembly. The motor shall have a standard NEMA C-Face, Class F insulation with a Class B temperature rise.
III. The VFD shall be of the PWM (Pulse Width Modulation) design using up to date IGBT (Insulated Gate Bipolar Transistor) technology.
IV. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
V. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
VI. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
VII. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain

desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

VIII. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

IX. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

X. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

XI. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

XII. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

XIII. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

XIV. The integrated VFD motor shall include protection against input transients, phase imbalance (via DC bus monitoring), loss of AC line phase (via DC bus monitoring), over-voltage, under-voltage, VFD over-temperature, and motor over-temperature.

XV. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
   a) Speed Reference Signal: 0-10 VDC, 4-20mA
   b) Digital remote on/off
   c) Fault Signal Relay (NC or NO)
   d) Fieldbus communication port (RS485)

XVI. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

E. Integral Controller Operating Modes

I. Proportional Differential Pressure – The head delivered shall be reduced from the programmed setpoint linearly or quadratically in accordance with decreases in flow demand in the system.

II. Constant Differential Pressure – A programmed constant head is maintained, irrespective of flow up to the maximum speed of the pump.

III. Constant Temperature – the pump shall adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.
IV. Constant Differential Temperature - the pump shall adjust speed to maintain a constant temperature drop between the flow pipe in which the pump is installed and a user installed temperature sensor.
V. Constant Curve – The pump runs as an uncontrolled pump by means of a set of pump curves. The pump curve shall be adjustable between maximum and minimum from the control panel or through an analog input.
VI. Alternating Operation – Two pumps shall communicate wirelessly to one another. In alternating operation, only one pump shall operate at a time. The operation shall alternate based on time or energy to ensure even run time of both pumps. If a pump stops due to fault the other pump shall take over automatically.
VII. Back-Up Operation – Two pumps shall communicate wirelessly to one another. In Back-Up operation one pump shall operate continuously. If the duty pumps stops due to fault the back-up pump shall take over automatically.

F. Interface And Communication

I. The pump shall have an integrated operator interface consisting of:
   i. Minimum 2.4" (measured diagonally) color TFT display
   ii. 7 push buttons for navigation of menu
   iii. Push Buttons must be able to operate at minimum 25,000 times
   iv. Push Buttons must be isolated from the main supply by reinforced insulation according to UL60730
   v. LEDs to signal pump status for quick indication
   vi. The pump shall have two analog inputs configurable for either 4-20mA or 0-10VDC input. Each analog input shall be configurable for pressure, flow, or temperature measurement. Differential pressure or differential temperature control shall be possible using two separate analog signals. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
II. The pump shall have 3 Digital Inputs galvanically isolated from the main supply by a reinforced insulation according to UL60730.
   a. Start/Stop –Used to start or start the pump. The pump shall be enabled when connected to common ground by an external potential free short circuit. An open circuit to this input shall disable the pump. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
   b. Minimum – used to force the pump to run at minimum load (curve). When connected to common ground by an external potential free short circuit the pump must run at minimum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
   c. Maximum - used to force the pump to run at maximum load (curve). When connected to common ground by an external potential free short circuit the pump must run at maximum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
III. The pump shall have two Output Relays. Each relay shall be configurable for Alarm, Ready, or Operating indication. Output relay contacts shall be rated for maximum 250VAC at 2A and minimum 5VDC at 20mA. Each must have galvanic isolation from the internal supply by reinforced insulation according to UL60730.
IV. Shall be capable of accepting an optional add-on module for integration into Building Management Systems: BACnet IP or MSTP Modbus.

2.3 AUTOMATIC CONDENSATE PUMP 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. Little Giant Pump Co. (Basis-of-Design)
2. Grundfos Pumps Corporation
3. Diversitech

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch minimum, electrical power cord with plug.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
2. Bronze startup and bronze or stainless-steel permanent strainers.
3. Bronze or stainless-steel straightening vanes.
4. Drain plug.
5. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage port**s** 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 the 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 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing 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. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations.
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and vibration isolation hangers of size required to support weight of in-line pumps.

1. Comply with requirements for vibration isolation and seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for 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 balancing valve, check valve, and shutoff valve on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of end-suction and horizontal split case pumps on suction side of pumps. For all other pumps, install Y-type strainer and shutoff valve on suction side of 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 or 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. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. 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 the pump is bound or drags, do not operate until the cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains and preparing pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT 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. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4-inch equals 1 foot.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8/A5.8M.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Danfoss Inc.
b. Heldon Products; Henry Technologies.
c. Parker Hannifin Corp.
d. Paul Mueller Company

2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
   d. Paul Mueller Company

2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.
4. Operator: Rising stem.
5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
6. Seal Cap: Forged-brass or valox hex cap.
7. End Connections: Socket, union, threaded, or flanged.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
   d. Paul Mueller Company

2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arkema Inc.
    b. DuPont Fluorochemicals Div.
    c. Genetron Refrigerants; Honeywell International Inc.
    d. Mexichem Fluor Inc

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

3.3 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. 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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE 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 pipe and fittings before assembly.

C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 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. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

D. Support multi-floor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

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.

1.2 SUMMARY

A. Section includes the following HVAC water-treatment systems:

1. Manual chemical-feed equipment and controls.
2. Stainless-steel pipes and fittings.
3. Chemical treatment test equipment.
4. Chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. TSS controllers.
6. Biocide feeder timers.
7. Chemical solution tanks.
8. Injection pumps.
9. Chemical test equipment.
10. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.

C. 1. Include plans, elevations, sections, and attachment details.

1. Include diagrams for power and control wiring.

D. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

E. Field quality-control reports.

F. 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 "Performance Requirements" Article.
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.

G. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.5 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Nalco Company.
2. Cascade Water Services Inc.
3. Barclay Chemical.

2.2 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 to 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, glycol cooling, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

D. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal.
2. Minimum Working Pressure: 125 psig.

2.4 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

B. Stainless-Steel Fittings: Comply with ASTM A 815/A 815M, Type 316, Grade WP-S.

C. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351/A 351M, 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 Steam Working Pressure and 600-psig Cold Working Pressure rating.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TSS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers; and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.
2. Four-station rack for open-loop systems.

2.6 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 "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 seismic restraints for equipment and floor-mounting accessories and anchor to building structure. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install water-testing equipment on wall near water-chemical-application equipment.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating 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 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."

E. See Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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 system's 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 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.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.5 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 hot water piping 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. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

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.

END OF SECTION 232500

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”
2. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”
3. Division 23 Section "Testing, Adjusting, and Balancing for HVAC"
4. Division 23 Section “HVAC Insulation”
5. Division 23 Section "Air Duct Accessories"

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 shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
1. 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.

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.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
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, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

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 NYS licensed professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: 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. Duct installation in congested spaces, 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.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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."

2.2 SINGLE-WALL ROUND 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.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," 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 (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.3 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.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. 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.

E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA Inc.
    b. Armacell LLC.
    c. Rubatex International, LLC

2. 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.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 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, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel, aluminum, or stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) 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.

b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. 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 (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 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. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. 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 (2500 Pa), 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.

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, sealant shall have 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 (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) 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.

2.6 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.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

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.

2.7 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.

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 492, stainless-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.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate the 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 the 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 (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

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 (38 mm).

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 "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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. Do not use two-part tape sealing system.

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.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. All Ducts: Seal Class A (All Transverse joints, longitudinal seams, and duct wall penetrations)

2. Seal Class is intentionally more stringent than standard SMACNA duct sealing requirements.
3. The maximum leakage allowed in cfm/sf is to be referenced against the seal class listed above and the definitions of seal class from Table 4-1 of the SMACNA HVAC Air Duct Leakage Test Manual.

Seal Class	**Leakage Class Allowed**
A	6
B	12
C	24
Round Duct, all classes	3

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) 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 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).

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.

3.5 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."

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

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.

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 the 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.

3.6 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.

3.7 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. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Indoor ducts with a pressure class higher than 3-Inch wg, ducts in risers, and supply ducts upstream of terminal units (e.g. VAV boxes, reheat coils, etc.):
        1) Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
        2) If any of the representative duct sections fail leak testing, then an additional representative duct section totaling no less that 25 percent of total installed duct area shall be tested.
        3) If any section of the second 25 percent fails, then the entire system shall be leak tested.
    b. Outdoor ducts, product-conveying exhaust ducts, and pressurization-critical exhaust ducts:
        1) Test 100 percent of total installed duct area for each designated pressure class.
    c. Leakage test requirements are intentionally more stringent that standard SMACNA requirements.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. 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.
6. 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 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 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.
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.

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Shower exhaust ducts up to the main exhaust duct connections: aluminum

B. Duct Pressure Class Schedule:

Air System	**Pressure Class**
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	1-inch wg
Ducts Connected to Air-Handling Units	2-inch wg
Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:	1-inch wg
Ducts Downstream of VAV Boxes	1-inch wg
Ducts Upstream of VAV Boxes	2-inch wg

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

2. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

D. Liner:

1. Supply Air Ducts, 20 feet downstream of supply fan connection: Flexible elastomeric 1 inch (25 mm) thick.
2. Return Air Ducts, 20 feet upstream of return fan connection: Flexible elastomeric 1 inch (25 mm) thick.
3. Exhaust Air Ducts, 20 feet upstream of exhaust fan connection: Flexible elastomeric 1 inch thick.
4. Return- and Exhaust-Fan Plenums: Flexible elastomeric 2 inches (51 mm)] thick.
5. Transfer Ducts: Flexible elastomeric 1 inch (25 mm) thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

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.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Flange connectors.
9. Duct silencers.
10. Turning vanes.
11. Remote damper operators.
12. Duct-mounted access doors.
13. Flexible connectors.
14. Flexible ducts.
15. Duct accessory hardware.

B. Related Requirements:

1. Division 28 Section "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product.

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 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a 2D finish for concealed ducts and 2B finish for exposed ducts.

C. 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.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. 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.

2.3 BACKDRAFT 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. American Warming and Ventilating; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 3000 fpm.

D. Maximum System Pressure: 4-inch wg.

E. Frame: Hat-shaped, 20 gage roll-formed galvanized steel or 0.125-inch extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 28 gage roll-formed galvanized steel or 0.070-inch extruded aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Nonmetallic or plated steel.

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.

4. Chain pulls.
5. Screen Mounting for open installations:
    a. Front mounted in sleeve.
        1) Sleeve Thickness: 20 gage minimum.
        2) Sleeve Length: 6 inches minimum.
    b. Screen Mounting: Rear mounted.
    c. Screen Material: Galvanized steel or Aluminum.
    d. Screen Type: Insect.
6. 90-degree stops.

2.4 BAROMETRIC RELIEF 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. American Warming and Ventilating; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Vent Products Company, Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 1000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades:

1. Multiple, 0.050-inch- thick aluminum sheet.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. End pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Stainless steel.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. 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. Greenheck Fan Corporation.
   d. Nailor Industries Inc.
   e. Pottorff.
   f. Ruskin Company.
   g. Vent Products Company, Inc.

2. Performance
   a. Comply with AMCA 500-D testing for damper rating.
   b. Pressures to 4.0 in wg.
   c. Velocities to 2000 fpm.
   d. Temperatures to 180 degF.

3. Linkage outside airstream and concealed in jamb.
4. Suitable for horizontal or vertical applications.
5. Frames:

   a. Frame: Hat-shaped, 0.094-inch- thick galvanized sheet steel, 0.10-inch- thick aluminum sheet channels, or 0.05-inch- thick stainless steel to match material of connecting ductwork.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

   a. 6″ wide.
   b. Multiple blade.
   c. Opposed-blade design.
   d. Stiffen damper blades for stability.
   e. Galvanized-steel, extruded aluminum, or stainless-steel to match frame material.

7. Blade Axles: Plated steel.
8. Bearings:

   a. Molded synthetic.
   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.

9. Tie Bars and Brackets: Galvanized steel or aluminum to match frame material.

B. Jackshaft:

1. Size: 0.5-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.

C. 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.

2.6 CONTROL DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pottorff Low Leakage Dampers

1. American Warming and Ventilating; a division of Mestek, Inc.

B. Low-leakage rating, with linkage outside airstream and concealed in frame, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
1. Leakage shall be less than 3 cfm/sq ft at 1-inch of static pressure.
2. AMCA licensed as a Class 1A damper.

C. Frames:

1. Hat shaped.
2. 16 gage galvanized steel or 0.125-inch-thick aluminum to match material of connecting ductwork
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel with double skin construction or Extruded Aluminum to match frame material.
4. Airfoil shaped.
5. Blade Edging: Closed-cell neoprene.

E. Blade Axles: 1/2-inch- diameter; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 72 to plus 275 deg F.

2. Removable control shaft extends 6 inches beyond frame.

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.

2.7 DYNAMIC FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.
2. Greenheck Fan Corporation.
3. Ruskin.
4. Air Balance Inc.; a division of Mestek, Inc.
5. Nailor Industries Inc.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours, as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

E. Integral Sleeve Frame:
1. Material: 20 gage roll formed galvanized steel.
2. Frame and sleeve are roll formed together as one-piece integral sleeve frame.
3. Length: 16 inches.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades:
1. Style: Curtain type, out of airstream.
2. Action: Spring or gravity closure upon fusible link release.
3. Material: 24 gage roll formed, galvanized steel.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: UL listed, Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.8 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff Company.
2. Greenheck Fan Corporation.
3. Ruskin.
4. Air Balance Inc.; a division of Mestek, Inc.
5. Nailor Industries Inc.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Leakage: Class I.

D. Frame: 5 inches thick, 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners.
   1. Style: Airfoil-shaped, single piece, double skin.
   2. Action: Opposed.
   3. Orientation: Horizontal.
   4. Material: Minimum 14 gage equivalent thickness, galvanized steel.
   5. Width: Maximum 6 inches.

E. Bearings: Self-lubricating stainless-steel sleeve, turning in extruded hole in frame.

F. Seals:
   1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degF.
   2. Jamb: Stainless steel, flexible metal compression type.

G. Linkage: Concealed in frame.

H. Rated pressure and velocity to exceed design airflow conditions.

I. Mounting Sleeve: Factory-installed, 20 gage galvanized sheet steel; minimum 12 inches long.

J. Master control panel for use in dynamic smoke-management systems.

K. Damper Motors: Modulating or two-position action.

L. 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" and 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.

M. Accessories:

   1. Auxiliary switches for position indication.
   2. Test and reset switches, remote mounted.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.
2. Greenheck Fan Corporation.
3. Ruskin.
4. Air Balance Inc.; a division of Mestek, Inc.
5. Nailor Industries Inc.

B. Type: 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 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours, as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

E. Leakage: Class I.

F. Frame: 5 inches thick, 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners.

G. Blades:
1. Style: Airfoil-shaped, single piece, double skin.
2. Action: Opposed.
3. Material: Minimum 14 gage equivalent thickness, galvanized steel.
4. Width: Maximum 6 inches.

H. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

I. Seals:
1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degF.
2. Jamb: Stainless steel, flexible metal compression type.

J. Linkage: Concealed in frame.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 20 gage galvanized sheet steel; minimum 12 inches long.

M. Actuator:
1. Type: Electric 120 V, 60 Hz, two-position, fail close.
2. Mounting: External or internal as required for access.

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" and 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 position indication.
2. Test and reset switches, remote mounted.

2.10 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: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.11 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Industrial Acoustics Company.
2. Vibro-Acoustics.
3. Pottorf.
4. Price.
5. Ruskin.

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.

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.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.040 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, 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: 0.05 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch (1.62 mm) thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034-inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss to achieve STC 45.

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. Film-lined type with fill material.

    a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent.
    b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

3. Lining: Tedlar.

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. Joints: Lock formed and sealed.

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. Integral 1-1/2-hour fire damper with access door. Access door to be high transmission loss to match silencer.
2. Factory-installed end caps to prevent contamination during shipping.
3. Removable splitters.
4. Airflow measuring devices.

L. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.12 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. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. 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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.13 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Young Regulator Company.
2. Ventfabrics, Inc.
3. Pottorff.

B. Description: Cable system with gear drive and controller designed for remote manual damper adjustment.

C. Control Wire: Stainless steel encapsulated in flexible galvanized spiral wire sheath.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Zinc.

2.14 DUCT-MOUNTED ACCESS DOORS

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. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. 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 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: Continuous piano hinge and cam latches.
e. 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: Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.15 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 0.0528-inch carbon or 0.0428-inch stainless steel.

D. Fasteners: Carbon or 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.

2.16 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. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. 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.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two 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. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. 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.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.17 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Flexmaster U.S.A., Inc.
2. Thermaflex.
3. Hart & Cooley, Inc.
4. Casco.

B. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: R-4.2 minimum at 75 degF.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus type.

2.18 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 back-draft dampers on exhaust discharges and outside air intakes. Coordinate with fan specification to determine if backdraft dampers are already provided at the fan unit.

D. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

1. All outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

E. 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.

F. Provide concealed remote volume damper operators for all volume dampers in inaccessible locations. Operator shall be installed within the ceiling or wall such that the unit is flush with the finished surface. Operators for diffusers shall not be located in active supply portions of the diffuser but may be installed in blank-off locations and/or return diffusers. Coordinate location of operator with the Engineer.

G. Set dampers to fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

I. Provide fire and smoke dampers, fire dampers at locations where ducts and outlets pass through fire rated components taking into account the matching of fire area to that of the

adjacent duct. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

1. Install fire, smoke, and combination fire and smoke dampers according to UL listing.
2. Install all dampers in accordance with SMACNA fire damper guide and manufacturer's instructions.
3. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
4. Install dampers square and free from racking with blades running horizontally.
5. Do not compress or stretch damper frame into duct or opening.
6. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
7. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

J. Connect ducts to duct silencers with flexible duct connectors.

K. 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. Control devices requiring inspection.
8. Elsewhere as indicated.

L. Install access doors with swing against duct static pressure.

M. 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.

N. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

O. Install flexible connectors to connect ducts to equipment.

P. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

Q. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.

R. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place. Do not use flexible ducts to change directions.

S. Connect flexible ducts to metal ducts with draw bands.

T. Install duct test holes where required for testing and balancing purposes.

U. 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 (6-mm) 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 233300

SECTION 233400 - 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.

1.2 SUMMARY

A. Section Includes:
   1. Centrifugal roof exhaust fans.
   2. In-line centrifugal fans.

1.3 SUBMITTALS

A. Product Data:

   1. Include rated capacities, furnished specialties, and accessories for each fan.
   2. Certified fan performance curves with system operating conditions indicated.
   3. Certified fan sound-power ratings.
   4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   5. Material thickness and finishes, including color charts.
   6. Dampers, including housings, linkages, and operators.
   7. Roof curbs.
   8. Fan speed controllers.

B. Shop Drawings:

   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   5. 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 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 reports.

E. Operation and Maintenance Data: For centrifugal fans 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, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.5 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 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. Twin City Fan & Blowers (Basis-of-Design)
2. Loren Cook Company
3. PennBarry
4. Greenheck

B. Housing: Removable, spun-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.

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. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Overall Height18 inches.
2. Sound Curb: Curb with sound-absorbing insulation.
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.
5. Burglar Bars: 3/4-inch thick steel bars welded in place to form 6-inch squares.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 IN-LINE CENTRIFUGAL 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. Twin City Fan & Blowers (Basis-of-Design)
2. Loren Cook Company
3. PennBarry
4. Greenheck

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet 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.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 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 Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.

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.

D. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and hangers. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

G. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

H. Unit Support: Install fans level on structural curbs or pilings. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

I. Isolation Curb Support: Install fans on isolation curbs and install flexible duct connectors and vibration isolation and seismic-control devices.

1. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
2. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation and seismic-control devices.

J. Install units with clearances for service and maintenance.

K. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans 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 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 test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.
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. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fans.

END OF SECTION 233416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bypass, single-duct air terminal units.
2. Shutoff, single-duct air terminal units.
3. Parallel, fan-powered air terminal units.
4. Series, fan-powered air terminal units.
5. Casing liner.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

B. Sustainable Design Submittals:

C. Shop Drawings: For air terminal units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

D. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Include design calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. 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:

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturer: Envirotech (Basis of Design)

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.040-inch-thick galvanized steel, single wall.

1. Casing Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections, size matching inlet size.
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.

D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from zero to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.

E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally open.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

G. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

1. Electronic Damper Actuator: 24 V, powered open, capacitous return.
2. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
3. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
4. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg and shall have a multipoint velocity sensor at air inlet.
5. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

    a. Occupied and unoccupied operating mode.
    b. Remote reset of airflow or temperature set points.
    c. Adjusting and monitoring with portable terminal.
    d. Communication with temperature-control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

6. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

H. Controls:

1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
2. System-powered, wall-mounted thermostat.

I. Control Sequences:

1. Occupied:

    a. In a call for cooling, airflow will increase as the damper opens towards maximum setting to satisfy set point.
    b. In a call for less cooling, airflow will decrease as the damper closes towards minimum setting to satisfy set point.

2. Unoccupied:

    a. Damper closes to minimum maximum setting.

2.3 CASING LINER

A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Minimum Thickness: 1 inch.

a. Maximum Thermal Conductivity:

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. 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.
3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. 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.
2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

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 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.

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.

3.2 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. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."

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. 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 before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify 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. 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.

3.3 TERMINAL UNIT 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. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

E. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties," and 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.

F. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

G. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

H. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Linear slot diffusers.

B. Related Requirements:

   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
   3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
   4. Section 233716 "Fabric Air-Diffusion Devices" for continuos tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturer: Kruger (Basis of a design)

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel.

D. Finish: Baked enamel, color selected by Architect.

E. Face Size: 24 by 24 inches.

F. Face Style: Plaque.

G. Mounting: Surface, T-bar.

H. Pattern: Adjustable.

I. Dampers: Radial opposed blade.

J. Accessories:

1. Equalizing grid.
2. Plaster ring.
3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

2.2 LINEAR SLOT DIFFUSERS

A. Manufacturer: Kruger (Basis of a design)

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material - Shell: Steel.

D. Material - Pattern Controller and Tees: Aluminum.

E. Finish - Face and Shell: Baked enamel, black.

F. Finish - Pattern Controller: Baked enamel, black.

G. Finish - Tees: Baked enamel, color selected by Architect.

H. Slot Width: 1 inch.

I. Number of Slots: One.

J. Length: 60 inches.

K. Accessories: Plaster frame, T-bar slot.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers level and plumb.

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 with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.43 - SECURITY REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes security registers and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale.

PART 2 - PRODUCTS

2.1 SECURITY REGISTERS

A. Security Register:

1. Manufacturer: Krueger (Basis of design)
2. Security Level: Maximum.
3. Application: Ducted, return, Air transfer Barrier.
4. Material: Steel.
5. Material Thickness: 0.19 inch.
6. Finish: Baked enamel, color selected by Architect.
7. Face Arrangement:

    a. Shape: Rectangular.
    b. Design: Fixed bar.
    c. Frame: Yes.
    d. Deflection: 38 degrees.
    e. Core: None.
    f. 3/16-inch- thick, front lattice plate with 2-by-2-inch- square holes and 1-inch frets, 0.135-inch wire mesh, and 1/4-inch- thick backer plate.
    g. 3/16-inch- thick, perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
    h. 1-1/2-inch bars and mandrel tubes and rods with [zero] [15]-degree deflection in 1-1/4-by-1-1/4-by-3/16-inch angle border.
    i. 1-3/8-inch bars and double mandrel tubes with [zero] [15]-degree deflection in 1-3/4-inch angle border.

8. Damper Operation: None.

9. Damper Type: Adjustable opposed blade.
10. Wall Sleeve: 3/16 inch welded to face.
11. Mounting: 1-by-1-by-3/16-inch retaining angle frame and tamperproof machine screws.

2.2 SECURITY GRILLES

A. Security Grille:
1. Manufacturer: Krueger (Basis of design)
2. Security Level: Maximum.
3. Application: Ducted return or Air transfer.
4. Material: Steel.
5. Material Thickness: 0.19 inch.
6. Finish: Baked enamel, color selected by Architect.
7. Face Arrangement:

    a. Shape: Rectangular.
    b. Design: Fixed bar.
    c. Frame: No.
    d. Deflection: 38 degrees.
    e. Core: None.
    f. 3/16-inch- thick, front lattice plate with 2-by-2-inch- square holes and 1-inch frets, 0.135-inch wire mesh, and 1/4-inch- thick backer plate.
    g. 3/16-inch- thick perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
    h. 1-1/2-inch bars and mandrel tubes and rods with [zero] [15]-degree deflection in 1-1/4-by-1-1/4-by-3/16-inch angle border.
    i. 1-3/8-inch bars and double mandrel tubes with [zero] [15]-degree deflection in 1-3/4-inch angle border.

8. Wall Sleeve: 3/16 inch welded to face.
9. Mounting: 1-by-1-by-3/16-inch retaining angle frame, 1-1/4-by-1-1/4-by-3/16-inch cast-in-place frame and tamperproof machine screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.43

SECTION 234400 – UV-C LAMP 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 UV-C lamp system installed within air-handling units with capacities, characteristics, and configurations as indicated on Drawings. Air handling units provided by others include space allotted to accommodate UV-C lamp system designed and installed under this section in accordance with drawing requirements.

B. Related Requirements:

1. Section 237313.19 "Indoor, Custom Air-Handling Units"

1.3 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Product information organized to show compliance with each performance requirement of "Performance Requirements" Article.
2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
3. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
4. UV-C lamp systems product data with performance ratings.

B. Shop Drawings: For each type and configuration of indoor, custom air-handling unit.

1. Include plans, elevations, sections, and mounting and attachment details for UVC system assembly within air handling units provided by others.
2. Use actual dimensions of internal equipment in preparing Shop Drawings. Identify mechanical equipment shown on Shop Drawings with equipment designations on Drawings.
3. Size, shape, and layout of base members including localized support of internal components.
4. Recommended points of field attachment with dimensioned locations.
5. Location of UV-C lamp systems, service clearances, and mounting details.
6. Size and location of junction boxes used for interface with field electrical power.
7. Point-to-point electrical power wiring diagrams including wire size, conduit size, motor controllers sizes, switch types and ratings, receptacle types and ratings, service light fixture types, and ratings.

8. Point-to-point control wiring diagrams including cable types and sizes, conduit sizes, and connected control devices.
9. Point-to-point control tubing diagrams including tubing types and sizes, conduit sizes, and connection controls devices.
10. Control panel drawings drawn to scale showing detailed internal layout.
11. Indicate code, operating, and maintenance clearances drawn to scale using dashed lines.

C. Comparison Schedule:

1. Submit a schedule to indicate performance of equipment scheduled on Drawings directly compared to performance of submitted equipment.
2. Clearly identify each line in schedule to indicate "Scheduled" where indicating performance scheduled on Drawings and "Submitted" where indicating performance of submitted equipment.
3. Organize schedule to first indicate performance scheduled on Drawings on one line followed by line directly below that indicates performance of submitted equipment.
4. Comparison schedule shall follow arrangement and organization of scheduled information indicated on Drawings.
5. Submitted equipment shall have a value for each scheduled value indicated.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 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. UVC Lamps: One additional lamp for each air-handling unit.

1.6 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components that fails in materials or workmanship within specified warranty period.

1. UVC Ballast Warranty: 5 year labor and 5 year material warranty from date of CUNY acceptance.

2. UVC Lamp Warranty: 5 year labor and material warranty from date of CUNY acceptance.

3. UVC Control Panel Warranty: 5 year labor and 10 year material warranty from date of CUNY acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handing units and components.

C. Safety:

1. Comply with OSHA regulations.
2. Exposed sharp edges and corners of metal shall be protected or rounded to prevent injury to personnel not wearing gloves.
3. Cover exposed ends of screws with plastic or metal covers to prevent injury to personnel coming in contact with screws.

D. Serviceability:
1. Mounting Location: Install internal components in readily accessible locations to facilitate ease of service and replacement.
2. Service Access:

a. Internal components shall be serviceable through access sections with doors indicated on Drawings.
b. Internal components shall be removable and replaceable through access doors or panels.
c. Review air handling unit shop drawings for access doors and panels indicated and recommend additional access doors and panels if required for uninhabited service, removal, and replacement of components.

3. Tripping Hazards: Floors in accessible sections of air-handling unit shall be free of standing seams, reinforcing, supports, or section splits located in the walking path that is capable of causing a tripping hazard. Locate section splits immediately adjacent to internal walls.

E. Quality: Type and thickness of materials indicated are the minimum acceptable. Provide better-quality materials of a heavier thickness if required to comply with performance requirements indicated.

1. If manufacturer's standard construction exceeds requirements indicated, use manufacturer's standard construction.
2. If manufacturer's standard construction does not comply with requirements indicated, modify manufacturer's standard construction to comply with requirements.

2.2 CAPACITIES AND CHARACTERISTICS

A. See equipment schedules on Drawings.

2.3 SOURCE LIMITATIONS

A. Like components furnished for each air-handling units shall be from same manufacturer.

2.4 ANTIMICROBIAL ULTRAVIOLET (UV-C) LAMP SYSTEMS

A. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Steril-Aire, Inc.
   2. American Ultraviolet
   3. UV Resources

B. Source Limitations: Obtain lamp systems from single source from single manufacturer.

C. Description: UV-C lamp system consisting of power supply, wiring, control panel, ballast panel, ballasts, lamp(s), plug(s), and holder(s) used for ultraviolet germicidal irradiation (UVGI) of cooling coil and condensate drain pan.

D. Certification: NRTL listed and labeled in accordance with UL 153, UL 1598, and UL 1995; UL Category Code ABQK; HVAC accessories; air-duct mounted.

E. Performance:

   1. Operating Conditions: Suitable for operation in extreme conditions of the airstream encountered.

      a. Relative humidity range not less than 5 to 100 percent.
      b. Temperature range not less than 34 to 158 deg F (1 to 70 deg C).
      c. Velocity range not less than 0 to 600 fpm (0 to 3 m/s).
   2. Irradiation Intensity: Install sufficient quantity of UVGI fixtures to provide an average irradiation intensity indicated on Drawings.

      a. Submit calculations indicating high, low, and average irradiation intensity level across coil face area and drain pan.
      b. Intensity calculations shall be based on average output over a lamp life of 9000 hours and account for light output degradation over the lamp life.

   3. Lamp Life: Minimum of 9000 hours.
   4. Light Output Degradation: Reduction in light output shall not exceed 15 percent of initial lamp output over the rated lamp life.

F. Construction:

   1. Lamps:

      a. Type: High output, hot cathode; non-ozone producing.
      b. Output: UV-C energy, primarily at the 254-nm wavelength with a 360-degree energy distribution.
      c. Protective Sleeve: Hermetically sealed to provide protection against lamp breakage and to ensure that lamp contents from a broken lamp are contained.
      d. Labeling: Lamp wattage and model number visibly printed on all lamps.
      e. Mercury Content: Less than 8 Mg of mercury in each lamp.

f. Lamp Sourcing: Commercially sourced from more than one manufacturer for future replacement. Proprietary lamps available from only one manufacturer are unacceptable.

2. UV-C Lamp System Support Assembly

a. Aluminum or 300 series grade stainless steel framework rigidly attached to air-handling unit casing and adequately braced to provide ridge support of UV-C lamp systems that will not move or damage when leaned on or bumped into by operators.

3. Lamp Holders:

a. UV- and moisture-resistant materials designed to connect the lamp to the plug and ensure a watertight connection.
b. Adjustable positioning.

4. Wiring Loom: UV-C-resistant jacket materials with internal aluminum/Mylar shield.

a. Conduit: Loom covered with NRTL-listed flexible metal conduit, aluminum, or stainless steel.

5. Ballast Enclosure

a. UL 508 NEMA 3R enclosures with UVC ballasts, weather-tight for operating in cooling coil/fan section.

6. Power Supply: NRTL listed, single phase, 120 or 277 V ac as indicated, with a programmed rapid start.

a. Power Factor: High power factor, Class P, Sound Rated A, Type 1 Outdoor, and with inherent thermal protection and without polychlorinated biphenyl.
b. Wiring Harness: Plug and play.
c. Electrical Connection: Single electrical connection with service disconnect.

G. Air-Handling Unit UV-C System Field Assembly:

1. Install UV-C lamp systems in accordance with manufacturer's written instructions.
2. Location: Install UV-C lamp system array at locations indicated on Drawings.
3. UV-C Lamp System Support Assembly: Air Handling Unit Manufacturer will provide internal space allotment for system installation and acceptable frame securement methodology. Final placement and securement of UV-C lamp system vertical members shall be by UV-C system installer in accordance with UV-C system design and lamp selection. Refer to specification 237313.19.
4. Service Access: Lamps shall be easily replaceable from inside the air-handling unit.
5. Factory wire UV-C lamp systems internally and terminate at a disconnecting switch on the exterior of the air-handling unit casing.

a. Switch to include a lock-out/tag-out feature.
b. In addition to disconnecting switch, provide each access door accessible to UV-C lamp systems with a positon limit switch wired into UV-C lamp systems power circuit to de-energize power to UV-C lamp systems when door is opened.

6. Shipping: Package and ship UV-C lamps in protective containers for field installation.

    a. Label exterior of enclosures with detailed description of container contents, including air-handling unit designation.
    b. Ship UV-C lamps for each air-handling unit in separate containers.

H. UV-C Control Panel

1. UL 508 Control Panel
2. Panel capability to monitor amperage draw by UV-C system for visual readout or remote monitoring via Building Management System
3. NEMA 3R UVC Control Panel Enclosure
    a. Panel mounted amp display to permit personnel to view amperage for surveys, maintenance, recordings, and service repairs.
    b. Control panel shall include over-current protection; the ampere rating shall be not less than 115% of the full load current. The control panel shall be equipped with current sensors allowing for monitoring the UVGI array and indicating if there is a problem.
    c. Manual On/Off switch and reset safety devices ensure that personnel entering UVC section must reset the lights by physically leaving the air handling unit, closing all access doors, and then resetting the system at the UVC control panel before the UVC is energized.
    d. Current transducer and Digital/Analog amperage display factory mounted and pre-wired by factory with a 24VDC power supply and available for 4-20ma output to connect and/or alarm at building management system
    e. Lock Out / Tag Out capability to prevent tampering and unauthorized entry.
    f. ANSI/OSHA safety interlock switch on all access doors to all HVAC sections with UVC exposure.

I. UV-C Lamp System Status Monitoring:

1. Sourcing: Furnished by UV-C lamp system manufacturer with UV-C lamp systems.
2. Monitors operating status of UV-C lamps by measuring change in electrical current.
3. On/off status of lamps displayed by LED lights on face of local display unit.
4. BAS/Remote connection: On/off status relays, start, stop, and lighting KW input.
5. BAS BACnet integration capabilities.

2.5 SOURCE QUALITY CONTROL

A. NFPA Compliance:

1. NFPA 70: Electrical components, devices, and accessories shall be listed and labeled by a qualified testing agency, and marked for intended location and application.
2. NFPA 90A: Design, fabrication, and installation of air-handling units and components shall comply with NFPA 90A.

B. UL Compliance:

1. UL 1598 Certification: Air-handling unit UVGI shall be NRTL listed and labeled in accordance with UL 1598, "Luminaires."

2. UL 1995 Certification: Where indicated, air-handling unit components shall be NRTL listed and labeled in accordance with UL 1995, "Standard for Safety Heating and Cooling Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

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 air-handling units before installation. Reject units with physical damage, and air-handling unit components that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for the following before installation of system within air-handling units:

1. Structural substrate mounting and anchorage to verify actual sizes, types, and locations.
2. Piping systems to verify actual sizes, types, and locations of connections.
3. Ductwork and plenums to verify actual sizes, types, and locations of connections.
4. Electrical services and controls to verify actual sizes, types, and locations of connections.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PROTECTION DURING CONSTRUCTION

A. Internal Access: Keep access doors locked to maximum extent possible and restrict access to only authorized personnel.

1. Open access doors only during periods authorized work inside air-handling units is required.
2. Coordinate and monitor work inside air-handling units on a shift basis. Lock access doors once work is complete or at the end of each shift.
3. Immediately report unauthorized access and any observed damage to Owner.

3.3 ELECTRICAL CONNECTIONS

A. Install field power to each air-handling unit electrical power connection. Coordinate with air-handling unit manufacturer and installers.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.5 UV-C SYSTEM COMMISSIONING

A. UVC provider will verify on-site after completed installation that UVC system is provided with minimum scheduled intensities at all points of cooling coil and drain pan surfaces with ILT1400 (or equal) calibrated radiometer adhering to NIST standards in 254nm wavelength.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

B. Training shall include, but not be limited to, procedures and schedules related to performance, safety, startup and shut down, troubleshooting, servicing, preventive maintenance, and how to obtain replacement parts.
1. Controls: Calibration, cleaning, operation, service, removal and replacement, and spare parts.
2. UV-C Lamp Systems: Cleaning, operation, service, removal and replacement, and spare parts.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.

D. Written Acceptance: Obtain Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 234400

SECTION 235123 - GAS VENTS

1.1 SUMMARY

A. Section Includes: Listed double-wall vents.

B. Related Requirements:

1. Section 235113.11 "Draft Control Fans" for draft inducer fans, venturi-draft inducer fans, mechanical-draft vent fans, vent exhaust fans, and combustion-air fans.
2. Section 235113.16 "Vent Dampers" for motorized and barometric dampers.
3. Section 235116 "Fabricated Breechings and Accessories" for listed, refractory-lined metal breechings and field-fabricated metal breechings.
4. Section 235133 "Insulated Sectional Chimneys" for listed chimney liners; listed building-heating-appliance chimneys; listed, refractory-lined metal chimneys; and field-fabricated chimneys.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vents.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Navien Common Boiler Venting System (Basis of Design)

B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch (6-mm) airspace.

D. Inner Shell: ASTM B209, Type 1100 aluminum; ASTM B209, Type 3003 aluminum ASTM B209, or Type 3105 aluminum.

E. Outer Jacket: Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.
4. Termination: Antibackdraft.

PART 3 - EXECUTION

3.1 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Type L Vent: Vents for low-heat appliances.

C. Listed Special Gas Vent: Condensing gas appliances.

3.2 INSTALLATION OF LISTED VENTS

A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Lap joints in direction of flow.

E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. Sections include gas-fired, wall-hung condensing boilers, trim, and accessories for generating hot water.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For each boiler.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.

a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
b. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and sections, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for boiler, accessories, and components, from manufacturer.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranty.

F. Product Certificates:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. CSA B51 pressure vessel Canadian Registration Number (CRN).

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period. Where "prorated" is indicated, the boiler manufacturer will cover the indicated percentage of cost of replacement parts. With "prorated" type, covered cost decreases as age of equipment increases.

1. Warranty Period for Wall Hung Water-Tube Condensing Boilers:

a. Heat Exchanger and Tank: Free from defects in material and workmanship.
b. Warranty Coverage: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency in accordance with Table 6.8.1-6 and other requirements in Ch. 6 of ASHRAE/IES 90.1.

D. ASHRAE 90.2 Compliance: Boilers shall have minimum efficiency in accordance with Ch. 6 of ASHRAE 90.2.

E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 431, Subpart E, Appendix N.

F. Mounting Base: For securing boiler to structural wall.

1. Seismic Fabrication Requirements: Fabricate mounting base[and wall support and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.2 WALL-HUNG, FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Manufacturer: Navien NFB (Basis of Design)

B. Description: Factory-fabricated, -assembled, and -tested, fire-tube, forced-draft, condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Units are to be for water-heating service only.

C. Heat Exchanger: Corrosion-resistant Type 316 stainless steel.

D. Fire Tubes: Corrosion-resistant Type 316 stainless steel.

E. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel.

F. Burner: Natural gas, forced draft.

G. Blower: Centrifugal fan to operate during each burner-firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.

H. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

I. Ignition: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.

J. Integral Circulator: Cast-iron body and stainless steel impeller sized for minimum flow required in heat exchanger.

K. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel protective finish.
4. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

L. Capacities and Characteristics:

1. Heating Medium: Hot water.
2. Design Water-Pressure Rating: 100 psig.
3. Safety Relief Valve Setting: 125 psig.
4. Entering-Water Temperature: 130 deg F.
5. Leaving-Water Temperature: 150 deg F.

2.3 TRIM - FOR HOT-WATER BOILERS

A. Include devices sized to comply with ASME B31.1 and ASME B31.9.

B. Aquastat Controllers: Operating, firing rate, and high limit with manual reset.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gauge: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. High and low gas pressure switches.

F. Alarm bell with silence switch.

G. Boiler Air Vent: Automatic.

H. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

I. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.4 CONTROLS

A. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: All set points shall be adjustable.
3. Electric, factory-fabricated and field-installed panel to modulate burner and control burner-firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.

    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

4. Electric, factory-fabricated and field-installed panel to control burner-firing rate, to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 150 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 90 deg F.

    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual -reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm and low-water-level alarm.
b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

2. A BACnet communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. All monitoring and control features, which are available at the local boiler control panel, shall also be available at the remote operator workstation through the building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are shown on Drawings and specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to wire lugs nonfused disconnect switch and circuit breaker.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A959, Type 29-4C stainless steel pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 CONDENSATE-NEUTRALIZATION UNITS

A. Description: Factory-fabricated and -assembled condensate-neutralizing tank assembly of corrosion-resistant plastic material with threaded or flanged inlet and outlet pipe connections. Device functions to prevent acidic condensate from damaging grain system. It is to be piped to receive acidic condensate discharged from condensing boiler and neutralize it by chemical reaction with replaceable neutralizing agent. Neutralized condensate is then piped to suitable drain.

B. Tank features:

1. All corrosion-resistant material.
2. Suitable for use on all natural gas and propane boilers.
3. Includes initial charge of neutralizing agent.
4. Neutralizing agent to be easily replaceable when exhausted.
5. Inlet and outlet pipe connections.

C. Capsule Configuration:

1. Low-profile design for applications where boiler condensate drain is close to the floor.
2. Easily removed and opened for neutralizing agent replacement.
3. Multiple units may be used for larger capacity.

D. Tank Configuration:

1. Utilized where boiler is elevated or where tank is installed in a pit with tank top flush with floor.
2. Top easily removed for neutralizing agent replacement.
3. Internal baffles to channel flow for complete neutralization.
4. Integral bypass to prevent condensate backflow into appliance.
5. Multiple units may be used for larger capacity.

2.8 SOURCE QUALITY CONTROL

A. UL Compliance, Gas-Fired: Test gas-fired boilers for compliance with UL 2764. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

B. CSA Compliance: Test boilers for compliance with ANSI Z21.13-2017/CSA 4.9.

C. Performance Testing: Test and label boilers for efficiency to comply with AHRI 1500.

D. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

E. Test and inspect factory-assembled boilers, before shipping, in accordance with 2017 ASME Boiler and Pressure Vessel Code. Factory test boilers for safety and functionality; fill boiler with water, and fire throughout firing range, to prove operation of all safety components.

F. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Equipment Mounting:

1. Install floor-mounted boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install wall-hung boilers where indicated on Drawings using suitable hangers. Comply with manufacturer's mounting instructions.
3. Comply with requirements for vibration isolation and seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.2 PIPING CONNECTIONS

A. Comply with requirements for hydronic piping specified in Section 232113 "Hydronic Piping."

B. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. When installing piping adjacent to boiler, allow space for service and maintenance of condensing boilers. Arrange piping for easy removal of condensing boilers.

E. Install condensate drain piping to condensate-neutralization unit and from neutralization unit to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.

F. Install condensate piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.

G. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

H. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve, and union or flange at each connection.

I. Install piping from safety relief valves to nearest floor drain.

3.3 DUCT CONNECTIONS

A. Boiler Venting:

1. Install flue-venting kit and combustion-air intake.
2. Comply with all boiler manufacturer's installation instructions.
3. Field fabricate and install boiler vent and combustion-air intake.
4. Utilize vent and intake duct material, size, and configuration as indicated in boiler manufacturer's instructions and to comply with UL 1738.
5. Comply with all boiler manufacturer's installation instructions.
6. Connect boiler vent full size to boiler connections.
7. Comply with requirements in Section 235123 "Gas Vents."
8. Comply with all boiler manufacturer's installation instructions.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 FIELD QUALITY CONTROL

A. Testing Agency, Owner: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency, Contractor: Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative:

D. Tests and Inspections:

1. Perform installation and startup checks in accordance with manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

E. Boiler will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. 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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

1. Instructor shall be factory trained and certified.
2. Provide not less than four hours of training.

3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 235216

SECTION 236423.13 - AIR-COOLED, SCROLL WATER CHILLERS

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 design, performance criteria, refrigerants, controls, and installation requirements for air-cooled scroll compressor chillers.

1.3 DEFINITIONS

A. BAS: Building automation system.
B. GFI: Ground fault interrupt.
C. I/O: Input/output.
D. SCCR: Short-circuit current rating.
E. TEAO: Totally enclosed air over.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
2. Performance at AHRI standard conditions and at conditions indicated.
3. Performance at AHRI standard unloading conditions.
4. Minimum & maximum evaporator flow rates, and associated pressure drops.
5. Refrigerant capacity of water chiller.
6. Oil capacity of water chiller.
7. Fluid capacity of evaporator, in gallons.
8. Characteristics of safety relief valves.
9. Summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.

5. Diagrams for power, signal, and control wiring, clearly delineating field and factory wiring.
6. Schematic diagram of control system indicating points for field interface/connection.
7. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates: For certification required in "Quality Assurance" Article.

B. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.

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.

C. Installation instructions.

D. Startup service reports.

E. Sample Warranty

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.

D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Tool kit to include the following:

1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.

3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1-inch high.

B. Touchup Paint: 32 oz. container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.8 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have five years' experience with the type of equipment and refrigerant offered.

B. Regulatory Requirements: Comply with the codes and standards specified.
1. Comply with applicable Standards/Codes of AHRI 550/590, ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by New York State.
2. Units shall meet the efficiency standards of the current version of ASHRAE Standard 90.1, and FEMP standard 2012.

C. Chiller manufacturer plant must be ISO Registered.

D. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

C. Comply with the manufacturer's instructions for rigging and handling equipment.

1.10 WARRANTY

A. The refrigeration equipment manufacturer's guarantee shall be for a period of one year from date of Substantial Completion. The guarantee shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period, excluding refrigerant, including parts and labor.

B. Extended warranties include, but are not limited to, the following:
1. Compressor: Four (4) years extended compressor warranty, parts only (5 years total).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin Applied (Basis of Design)
B. Trane
C. Motivair Cooling Solutions

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water chillers 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 when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

B. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.

C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

F. Comply with NFPA 70.

G. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.

H. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
2. See drawings for equipment served by backup power systems.
3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

I. Outdoor Installations:

1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

J. Chiller shall be functionally tested at the factory to ensure trouble free field operation.

2.3 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.4 MANUFACTURED UNITS

A. Description: Factory-assembled, factory run-tested, and factory-charged air-cooled scroll compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic tandem scroll compressor sets (total four compressors), brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.

2.5 CAPACITIES AND CHARACTERISTICS

A. Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590.

B. Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F.

C. Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

D. Low Ambient Operation: Chiller designed for operation to minus 10 deg F.

E. High Ambient Operation: Chiller designed for operation to 125 deg F.

F. Chiller Electrical Characteristics: 208-V ac, three phase, 60 Hz.

G. Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

Sound Pressure at 30 Feet											
63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	**Overall dBA**	75% Load dBA	50% Load dBA	25% Load dBA
67	66	67	62	59	54	49	44	**64**	63	61	60
Sound Power											
63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	**Overall dBA**	75% Load dBA	50% Load dBA	25% Load dBA
94	93	94	89	86	81	76	71	**91**	90	88	87

2.6 UNIT CONSTRUCTION

A. Unit formed sheet metal components shall be painted using a corrosion resistant paint system, for aesthetics and long-term durability. Paint system will include a base primer with a high-quality polyester resin topcoat. Painted galvanized parts shall be G60 or greater and finished, unabraded panel surfaces shall be capable of withstanding an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16” at 1,000 hours minimum exposure to an ASTM B117 salt spray environment.

B. Upper section of unit shall have protective and decorative louvers covering the coils and unit end; base section of unit shall have protective, 12 GA, PVC-coated, wire grille guards and have painted steel wraps enclosing the coil end sections and piping.

C. Base: Heavy-gauge steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.

2.7 COMPRESSORS

A. The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

2.8 REFRIGERATION

A. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), non-bleed-type electronic expansion valve, and insulated suction line.

B. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.

C. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.

2.9 EVAPORATOR

A. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless-steel plates. Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor.

B. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.

C. The evaporator shall be protected with an external, electric resistance heater plate. The evaporator and suction piping to the compressors shall be insulated with 3/4" (19 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage. The insulation shall have an additional outer protective layer of 3mm thick PE embossed film to provide superior damage resistance. Insulation without the protective outer film shall not be acceptable. UV resistance level shall meet or exceed a rating of 'Good' in accordance with the UNI ISO 4892 - 2/94 testing method. This combination of a heater plate and insulation shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

D. The water-side maximum design pressure shall be rated at a minimum of 435 psig (3000 kPa). Evaporators shall be designed and constructed according to and listed by Underwriters Laboratories (UL).

2.10 AIR-COOLED CONDENSER

A. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

B. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Condenser coils shall include baked epoxy coating providing 10,000+ hour salt spray resistance (ASTM B117-90) applied to both the coil and the coil frames.

C. Hail Protection: Provide condenser coils with louvers to protect against hail damage.

D. Fan Guards: Removable, heavy-gauge vinyl-coated fan guard.

2.11 CHILLED-WATER HYDRONIC PACKAGE

A. Factory-furnished and -installed hydronic package consisting of the following:

1. The pump package shall be factory mounted and wired on the chiller. The chiller controller shall provide a pump start/stop signal when operation is required.

2. Pumps: dual pumps with capacity as indicated on drawings.

a. Dual Pumps in a Single Casting Model 4392: single-spring inside-seal vertical, in-line, radially split-case pumps, mounted in a common casing with a common inlet connection and outlet connection and including a flapper valve to prevent recirculation when only one pump is operating. An isolation valve shall be included to allow one pump to operate when the other is removed. The pumps shall be designed for duty/standby, not parallel operation
b. Cast-iron, ductile-iron, bronze, or stainless-steel body.
c. Bronze or stainless-steel impeller keyed to shaft and secured with screw.
d. Premium efficient motor with TEFC motor enclosure.
e. Dual pump packages to provide for servicing and replacement of failed pump with other pump operating.
f. Variable-speed pumps with variable-frequency controllers integral to pump motor or provided with chiller electrical package.

3. Piping: schedule 40 with Victaulic couplings.
4. Strainers: Y-type at suction side of pumps, 2.5 in size, 0.063 in maximum perforation size, and Victaulic couplings.
5. Combination triple-duty outlet valve having a drip-tight discharge shutoff valve, non-slam check valve, and flow throttling valve.
6. Combination suction guide with flow stabilizing outlet vanes and stainless-steel strainer with a disposable fine-mesh strainer for start-up on inlet pump piping.
7. Thermal dispersion type flow switch mounted and wired on evaporator outlet.
8. Factory install two water pressure guagues.

B. Hydronic package rated for same pressure as evaporator.

C. Pressure and leak tested before applying insulation.

D. Insulation on hydronic package shall match evaporator. All cold surfaces shall be insulated.

E. Controls:

1. Lead/lag operation for dual pump packages.
2. Controlled to automatically equalize run time.
3. Control of variable-speed pumps.
4. Integral to chiller control package.
5. Factory power and control wiring from the chiller to the pump package control panel

2.12 INSULATION

A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C534/C534M, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 3/4 inch.

B. Adhesive: As recommended by insulation manufacturer.

C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
6. Field-Applied Insulation:

a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.13 SOUND REDUCTION

A. Factory install acoustical blankets on each compressor. Maximum sound pressure and sound power levels indicated in the “CAPACITIES AND CHARACTERISTICS” section of this specification are the values without acoustical blankets.

2.14 UNIT SUPPORT

A. Provide chiller with seismic rating based on site SDS and importance factor levels. Seismic rating shall consist of OSHPD pre-approval for the model and configuration provided. Ensure rated SDS level is adequate for the installed location. Provide seismic rated spring isolators for secure mounting of the chiller to the base. Chiller shall be marked with a label showing the applicable OSHPD pre-approval number.

2.15 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Factory-installed and -wired single point field power electrical connection to a disconnect switch with compressor circuit breakers.

C. Each motor shall have overcurrent protection.

D. Ground Fault Protection: Factory installed circuit breaker to protect equipment from damage from line-to-ground fault currents less than those required for conductor protection.

E. Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

F. Service Receptacle:

1. Unit-mounted, 120-V GFI duplex receptacle.
2. Power receptacle from chiller internal electrical power wiring.

2.16 CONTROLS

A. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

B. Shall include high short circuit current rating of 65,000 amps (25,000 amps at 575Volt) with single-point disconnect switch

2.17 Unit Controller

A. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

B. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

C. Shutdown Alarms
1. No evaporator water flow (auto-restart)
2. Sensor failures
3. Low evaporator pressure
4. Evaporator freeze protection
5. High condenser pressure
6. Outside ambient temperature (auto-restart)
7. Motor protection system
8. Phase voltage protection

D. Limit Alarms
1. Condenser pressure stage down, unloads unit at high discharge pressures.

2. Low ambient lockout, shuts off unit at low ambient temperatures.
3. Low evaporator pressure hold, holds stage #1 until pressure rises.
4. Low evaporator pressure unload, shuts off one compressor.

E. Unit Enable Section
1. Enables unit operation from either local keypad, digital input, or BAS

F. Unit Mode Selection
1. Selects standard cooling, ice, glycol, or test operation mode

G. Analog Inputs:
1. Reset of leaving water temperature, 4-20 mA
2. Current Limit

H. Digital Inputs
1. Unit off switch
2. Remote start/stop
3. Flow switch
4. Ice mode switch, converts operation and setpoints for ice production
5. Motor protection

I. Digital Outputs
1. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
2. Evaporator pump; field wired, starts pump when unit is set to start

J. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

K. Building Automation System (BAS) Interface
1. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARK ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
2. BACnet MS/TP master (Clause 9)
3. BACnet IP, (Annex J)
4. BACnet ISO 8802-3, (Ethernet)
5. LONMARK FTT-10A. The unit controller shall be LONMARK® certified.
6. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
7. For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.
8. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.

B. Install water chillers on support structure indicated.

C. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Adjust and level chiller in alignment on supports.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Maintain clearances required by governing code.

F. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

G. Install separate devices furnished by manufacturer and not factory installed.

1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to chillers, allow space for service and maintenance.

C. Evaporator Fluid Connections:

1. Connect to evaporator inlet with shutoff valve, air vent, flexible connector, and Pete’s test plug.
2. Connect to evaporator outlet with shutoff valve, flexible connector, and Pete’s test plug.

3. Make connections to water chiller with a flange or mechanical coupling.

D. Connect each chiller with a drain valve on the bottom of the lower chilled water connection pipe.

E. Connect each chiller with a manual vent on top of the upper chilled water connection pipe.

3.4 ELECTRICAL POWER CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2-inch high. Locate nameplate where easily visible.

D. Coordinate electrical installation with electrical contractor.

3.5 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

C. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2-inch high.

E. Coordinate controls installation with controls contractor.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.

2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.

E. Prepare a written startup report that records results of tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions and provide electronic copy to Owner.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 236423.13

SECTION 237313.19 - INDOOR, CUSTOM 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, apply to this Section.

1.2 SUMMARY

A. Section includes indoor, custom air-handling units with capacities, characteristics, and configurations indicated on Drawings.

1.3 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Product information organized to show compliance with each performance requirement of "Performance Requirements" Article.
2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
3. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
4. Include unit dimensions and weight.
5. Include cabinet material, metal thickness, finishes, insulation, and accessories.
6. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated. For fans operating at variable speeds include curves in 10- percent speed increments starting at design speed down to minimum speed.
    b. Include fan-sound power ratings in all eight octave bands. Include inlet or outlet sound power levels to coincide with sound requirements indicated on Drawings.
    c. Include fan construction and accessories. Submit sufficient information to show product compliance with requirements indicated.
    d. Include dimensions and weight.
    e. Include motor ratings, electrical characteristics, and motor accessories.

7. Vibration isolation product data with performance ratings. Uniquely identify and include information for each different isolator type and indicate where each isolator type is being used.
8. Include certified coil-performance ratings with system operating conditions indicated. Product data to include dimensions, dry and operating weight, volume of fluid contained, materials of construction, and performance ratings with system operating conditions indicated.
9. Casing insulation product data and performance ratings.
10. Access door and access panel product data and performance ratings.

11. Paint product data and performance ratings.
12. Electrical product data and performance ratings.
13. Dampers product data, including housings, linkages, and operators with performance ratings.
14. Filters product data with performance characteristics.
15. Duct silencers product data with performance ratings.

B. Shop Drawings: For each type and configuration of indoor, custom air-handling unit.

1. Prepared by manufacturer's factory employees with review and sign-off by those individuals responsible for manufacturing the air-handling units.
2. Include plans, elevations, sections, and mounting details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection.
4. Indicate details of construction with materials description including applicable specified standards and material grades in sufficient detail for reviewers to evaluate point by point compliance with requirements indicated for each air-handling unit.
5. Thickness and finish of all casing materials with cross references indicated where each is used. Uniquely identify and include information for each different casing construction.
6. Details for each unique casing joint and reinforcing. Indicate wall joints, wall to floor joints, wall to roof joints, floor joints, and roof joints.
7. Assembly details of base and casing for units consisting of multiple sections requiring field assembly.
8. Sizes and dimensioned locations of field connections for ductwork, piping, electrical, and controls.
9. Base and casing penetration and sealing details for factory-installed conduit.
10. Base and casing penetration and sealing details for factory-installed piping including coils.
11. Details of casing connections to field-installed ductwork.
12. Size, shape, and layout of base members including localized support of internal components.
13. Base materials, thickness, finishes, lifting provisions, and mounting requirements. Uniquely identify and include information for each different base construction.
14. Recommended points of field attachment with dimensioned locations.
15. Size and location of each access door, including clear opening size, with door swing indicated.
16. Size and location of each access panel with service equipment superimposed to show relationship of panel to internal equipment.
17. Drain pans and associated piping, with sizes and locations dimensioned, including relationship to internal equipment.
18. Coil framework and support including enlarged details showing framework attachment to air-handling unit base, coil attachment to framework, and means for individual coil removal.
19. Mounting details of all internal components, such as fans, filters, and dampers.
20. Hoist rails layout for internal equipment showing size of members, attachments to structure, and serviced equipment superimposed to indicate relationships.
21. Location of UV-C lamp systems, service clearances, and mounting details.
22. Location of receptacles, service lights, and switches.
23. Size and location of junction boxes used for interface with field electrical power.
24. Point-to-point electrical power wiring diagrams including wire size, conduit size , switch types and ratings, receptacle types and ratings, service light fixture types and ratings.

25. Point-to-point control wiring diagrams including cable types and sizes, conduit sizes, and connected control devices.
26. Point-to-point control tubing diagrams including tubing types and sizes, conduit sizes, and connection controls devices.
27. Control panel drawings drawn to scale showing detailed internal layout.
28. Indicate code, operating, and maintenance clearances drawn to scale using dashed lines.
29. Indicate weights of internal components, weight of each separately shipped section, and air-handling unit total weight.

C. Comparison Schedule:

1. For equipment other than basis of design equipment, submit a schedule to indicate performance of equipment scheduled on Drawings directly compared to performance of submitted equipment.
2. Clearly identify each line in schedule to indicate "Scheduled" where indicating performance scheduled on Drawings and "Submitted" where indicating performance of submitted equipment.
3. Organize schedule to first indicate performance scheduled on Drawings on one line followed by line directly below that indicates performance of submitted equipment.
4. Comparison schedule shall follow arrangement and organization of scheduled information indicated on Drawings.
5. Submitted equipment shall have a value for each scheduled value indicated.

D. 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 professional engineer responsible for their preparation.

1. For 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.

    a. Include design calculations for selecting seismic restraints.
    b. AHU shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7

INFORMATIONAL SUBMITTALS

E. Seismic Qualification Data: Certificates for air-handling units, 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.
4. Restraint of internal components.

F. Startup service reports.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 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. Panel filters: One set equal to installed quantity.
2. Rigid Cell Box Filters: One set equal to installed quantity.
3. Access Door Gaskets: One set equal to installed quantity.

B. Tool Kit: Manufacturer to provide a tool kit including special tools required for air-handling unit service if unique or atypical tools are required.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 DELIVERY, STORAGE, HANDLING

A. Deliver air-handling units with factory-installed shipping skids and lifting lugs; pack small components in factory-fabricated protective containers. Cover units with heat-shrinkable plastic sheeting suitable for shipping from point of manufacture to Project.

B. Handle air-handling units carefully to avoid damage to components, casing, and finish. Do not install damaged components; replace and return damaged components to air-handling unit manufacturer.

C. Store air-handling units in a clean dry place and protect them from weather and construction activities.

D. Keep air-handling units fully covered and protected during construction. Remove dirt and debris and clean units to a factory-cleaned condition.

E. Comply with manufacturer's written rigging and installation instructions for unloading air-handling units and moving them to their final locations.

1.8 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of air-handling units that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

B. Extended warranties include, but are not limited to, the following:

1. Complete Air-Handling Unit: Five years from date of Substantial Completion for entire air-handling unit and longer where indicated for individual components.
   a. Where substantial completion dates are in excess of factory delivery and construction completion estimates and warranty coverage, the mechanical contractor shall extend the manufacturer warranty at no additional cost.
2. Air-Handling Unit Casing: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Alliance Air Products (Basis of Design)
   2. Air Wise (Alternate Manufacturer)
   3. TMI Climate Solutions (Alternate Manufacturer)

2.2 PRODUCT ACCEPTABILITY

A. Throughout the specifications, types of materials 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. Products of equal performance may be submitted as an alternate for consideration.

2.3 CAPACITIES AND CHARACTERISTICS

A. See equipment schedules on Drawings.

2.4 SOURCE LIMITATIONS

A. Like components furnished with air-handling units shall be from same manufacturer.

2.5 UNIT ARRANGEMENT AND CONFIGURATION

A. Arrangement: Project-specific arrangement and configuration of air-handling units as indicated on Drawings. Do not deviate from requirements indicated.

B. Mounting Requirements: Unit mounted on concrete housekeeping pad with height as indicated on project drawings.

C. Multiple Sections: Each air-handling unit shall consist of multiple sections for field assembly to comply with requirements indicated on Drawings.

2.6 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handing units and components.

C. Delegated Design: Engage a qualified professional engineer to design air-handling units, vibration isolation, and seismic restraints, including comprehensive engineering analysis, using performance requirements and design criteria indicated.

D. Casing Leakage Performance: Comply with more stringent of the following requirements:
1. Not more than 1 percent of the total unit airflow at 8 inches wg.

E. Casing Thermal Performance:
1. Thermal Break: Incorporate a thermal break at each through metal path to prevent condensation from occurring on interior and exterior of casing.
2. U-Value: Overall U-value or equivalent R-value of casing shall not exceed governing codes and ASHRAE/IES 90.1, while considering the effects of metal-to-metal contact and thermal bridging in calculations.

F. Air Tunnel Aerodynamic Performance: Position air-handling unit internal components and transition between internal components to maintain uniform airflow; minimize sound levels and energy consumption. Use methods indicated and other means to ensure compliance.

1. Use turning vanes if necessary to direct the air path.

a. Design, manufacture, and install vanes in accordance with applicable requirements in ASHRAE and SMACNA guidelines, handbooks, and standards.
b. Install vanes firmly in place so that no vane movement occurs at worst-case airflow capacity possible.

2. Use fan inlet and discharge transitions and other devices to maximize system regain and minimize airborne sound levels.
3. Center system components such as coils, fans, and filters, vertically and horizontally, in airstream.
4. Maintain spacing between components such that airflow patterns to adjacent components are as uniform as possible and that component "dead spots" or "jetted areas" are avoided.
5. Design and install internal structural supports, piping, and conduit that do not block airflow and impede performance of coils, fans, filters, and other unit components, and service space clearances.

G. Safety:

1. Comply with OSHA regulations.
2. Exposed sharp edges and corners of metal shall be protected or rounded to prevent injury to personnel not wearing gloves.
3. Cover exposed ends of screws with plastic or metal covers to prevent injury to personnel coming in contact with screws.

H. Serviceability:
1. Mounting Location: Install internal components in readily accessible locations to facilitate ease of service and replacement.
2. Service Access:

a. Internal components shall be serviceable through access sections with doors indicated on Drawings.
b. Internal components shall be removable and replaceable through access doors or panels.

3. Tripping Hazards: Floors in accessible sections of air-handling unit shall be free of standing seams, reinforcing, supports, or section splits located in the walking path that is capable of causing a tripping hazard. Locate section splits immediately adjacent to internal walls.

I. Quality: Type and thickness of materials indicated are the minimum acceptable. Provide better-quality materials of a heavier thickness if required to comply with performance requirements indicated.

1. If manufacturer's standard construction exceeds requirements indicated, use manufacturer's standard construction.
2. If manufacturer's standard construction does not comply with requirements indicated, modify manufacturer's standard construction to comply with requirements.

J. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined in accordance with 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."
2. Risk Category: IV
3. Component Importance Factor: 1.5
4. Seismic Design Category: C
5. Site Class: D
6. Ss: 0.247
7. S1: 0.056
8. Sms: 0.395
9. Sm1:0.134
10. Sds: 0.263
11. Sd1: 0.089
12. Component Amplification Factor: 2.25
13. Component Response Modification Factor: 3.5

K. Vibration Performance: Air-handling unit manufacturer shall evaluate vibration of internal components installed inside of air-handling units and include internal vibration isolation required to limit the vibration transmitted to the building at a low enough level that vibration is not perceived by building occupants.

2.7 AIR-HANDLING UNIT BASE

A. Performance:

1. Air-handling unit manufacturer shall design and assemble air-handing unit casing and internal components for attachment and support by air-handling unit structural base.
2. Design air-handling units to be lifted from only the air-handling unit structural base and not the casing.
3. Support air-handling units from only the perimeter base unless otherwise indicated on Drawings.
4. Air-handling unit manufacturer to size and locate intermediate structural base supports as required to comply with structural performance indicated for air-handling unit floors.

B. Structural Member Size:

1. Air-handling unit manufacturer shall select size of base members and construction of base to withstand the rigors of loading, unloading, shipping, and rigging without damage to air-handling unit components or misalignment of factory-assembled components.
2. Depth of perimeter base members is not less than 8 inches deep.

C. Welding Filler Metals: Comply with AWS welding codes for welding materials appropriate for thickness and chemical analysis of material being welded.

1. Use welding materials with corrosion properties equal to material being welded.

D. Welding Procedures:

1. Structural Welding Codes: AWS D1.2/D1.2M for aluminum.
2. After welding and fabrication, deburr and grind exposed welds to provide smooth surfaces free of sharp edges.

E. Section Joints: Air-handling units consisting of multiple sections for field assembly shall be joined with structural joining plates.

1. Joining plate material type to match base.
2. Joining plate of thickness required to join sections without resulting in a permanent deflection.
3. Joining plates shall not extend beyond outer edge of adjoining base.

F. Lifting Provisions: Air-handling unit manufacturer to design and install lifting lugs of size and location required to comply with performance requirements indicated. Lifting lugs extending beyond the base shall be easily removable in the field after unit is installed.

2.8 UNIT CASINGS

A. Casing Assembly:

1. Dissimilar Metals: Isolate dissimilar metals that are in contact to prevent galvanic action and corrosion.
2. Framing and Supports: Interconnect and support individual casing wall and roof panels using either formed panel construction or framed construction with structural support members.
3. Seals: Seal interior and exterior joints and seams to make casing air- and watertight. Trim factory-applied sealant flush with adjacent surface.

4. Double-Wall Casings: Consisting of insulation sandwiched between an outer and inner metal wall.
5. Penetrations: Seal voids around conduit, piping, and tubing penetrations.
   a. Conduit, Pipe, and Tube Sizes NPS 3 and Smaller:
      1) Seal void through casing with a nonhardening vapor-barrier caulk covered by an escutcheon on both interior and exterior sides of casing. Back caulk using formed insulation within a sheet metal sleeve.
      2) Seal void using a friction fit neoprene or EPDM sheet material attached to casing using a bed of adhesive.
      3) Cover penetration and sealing sheet material with metal escutcheon matching adjacent casing material.
   b. Larger Conduit, Pipe, and Tube Sizes: Seal annular void using an adjustable compression-type sealing sleeve.
6. Duct Connections - Direct to Casing: Frame and reinforce unit casing around perimeter of unit duct openings to accommodate direct attachment of field-installed ductwork.

B. Materials for Outer Skin of Casing Walls and Roofs:
   1. Aluminum Solid Sheet: ASTM B209; Alloy 3003-H14, smooth finish; minimum (nominal) 0.063 inch thick.

C. Materials for Inner Skin of Casing Walls and Roofs:
   1. Aluminum Solid Sheet: ASTM B209; Alloy 3003-H14, smooth finish; minimum (nominal) 0.032 inch thick.
   2. Stainless Steel Solid Sheet: ASTM A240 or ASTM A480; Type 304; minimum (nominal) 20 gauge thick.
   3. Application: See Drawings for application of different materials indicated.

D. Materials for Floor Walking Surface:
   1. Aluminum Diamond Treadplate: ASTM B632/B632M, Alloy 6061 T6; mill finish; minimum (nominal) 0.125 inch thick.

E. Materials for Underside of Floor Insulation:
   1. Aluminum Solid Sheet: ASTM B209; Alloy 3003-H14, smooth finish; minimum (nominal) 0.032 inch thick.

F. Insulation for Casing Walls and Roofs Not Exposed to Airstream:

   1. Materials Not Exposed to Airstream: Unfaced fiberglass insulation with a minimum nominal density of 1.5 lb/cu. ft.
   2. R-Value: Minimum R-14.
   3. Thickness: Minimum 4 inches.
   4. Insulation shall completely fill the casing cavity so no voids exist.

G. Insulation for Casing Floors:

   1. Materials: Urethane foams sheet insulation with a minimum nominal density of 2 lb/cu. Ft.
   2. R-Value: Minimum R-10.
   3. Thickness: Minimum 2 inches.
   4. Insulation shall completely fill the casing cavity so no voids exist.

H. Access Doors:

1. Application: Install access doors in air-handling units at locations indicated on Drawings.
2. Adjustment: Design doors for field adjustment capable of maintaining specified leakage rate.
3. Mounting Height: Install bottom of door frame within 2 inches of air-handling unit floor walking surface.
4. Performance: Leakage as required to satisfy overall unit leakage performance indicated, but not more than 2.0 cfm per door when tested at 8 inch wg.
5. Fabrication: Formed and reinforced, constructed of same materials and thicknesses as casing.
6. Frame: Extruded aluminum with thermal breaks.
7. Handles:

    a. Secure door closed using not less than two latches with handles located at quarter points along door height.
    b. Air-handling unit manufacturer has option to use a multipoint latching mechanism that is operable from a single door handle located at midpoint of door height, but secures door to frame at top, bottom, and handle location.
    c. Include door handles on outside and inside of door to allow operator access to open and close door from outside and inside of unit.
    d. Field adjustable to accommodate changes to fit and gasket compression.
    e. Durable product capable of withstanding repeated opening and closing of door while operating under design pressure without damage.
8. Gasket:

    a. Design: Specially formed with an internal air chamber specifically designed to seal on two surfaces without taking a permanent set.
    b. Location: Install gaskets around entire perimeter of doors or frames.
    c. Material: EPDM, neoprene, or santoprene.
    d. Service: Field replaceable.
    e. Adhesive-backed tape-type gaskets adhered to a single flat surface are unacceptable.

9. Size of Door Frame Clear Opening: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.

    a. Width: At least 18 inches clear inside of door frame.
    b. Height: At least 60 inches clear inside of door frame.
    c. Door sizes indicated on Drawings.

10. Safety Latches and Stops:

    a. Safety Latches: Install safety latch with retainers on outward swing doors that open against pressure to allow restricted travel for purpose of pressure relief and so that doors do not open uncontrollably due to inside pressure.
    b. Stops: Install cushioned door stops on inward swinging doors where necessary to limit door travel that could potentially damage the door or internal components.

11. Windows:

    a. Construction: Fabricate windows with frame mounted in access doors of double-glazed safety glass with an airspace between panes and interior and exterior seals.

b. Condensation Control: Install desiccant material in airspace between panes if necessary to prevent condensation from forming on glazing.
c. Clear Viewing Size: Minimum 8 inches square.
d. Application: Install windows in all access doors.

12. Nameplates:

a. On each access door, include a nameplate defining the access to service within. Nameplates shall be included for, but not be limited to, the following:

1) Dampers.
2) Filters.
3) Cooling Coils.
4) Heating Coils.
5) Duct Silencers.
6) UV-C Lamp Systems.
7) Supply Fans.
8) Return Fans.
9) Where door access is to multiple components, list all components accessed. For example: Filter/Cooling Coil.
10) For each door that does not open against static pressure, include a warning sign stating: "WARNING: DOOR UNDER POSITIVE PRESSURE."

b. Lettering Size and Style: At least 1-inch high, block style.
c. Material: Lettering engraved in black plastic on a white plastic back. Engraving shall penetrate through black plastic so lettering reads white.
d. Attachment: Attach nameplates to door using high-strength bonding cement and screws.
e. Mounting Location:
1) Align nameplates of all doors for uniform placement.

I. Access Panels:

1. Performance: Leakage as required to satisfy overall unit leakage performance indicated.
2. Fabrication: Formed and reinforced panels of same material and thickness as casing.
3. Fasteners: Adjustable, reusable type for multiple operations without degradation due to reuse.
4. Arrangement: Panels removable from exterior side of casing.
5. Gasket: EPDM, neoprene, or santoprene similar to access doors, applied around entire perimeter of panels or frames.
6. Location and Size:

a. Coils: Oversized access panel to allow removal and replacement without impacting adjacent casing.

7. Nameplates:

a. On each access panel, include a nameplate defining the access to service within. Nameplates shall be included for, but not be limited to, the following:

1) Cooling Coils.
2) Heating Coils.

2.9 INTERNAL STRUCTURAL SUPPORTS

A. General:

1. Air-handling unit manufacturer shall design and assemble air-handing unit internal structural supports for attachment and support by air-handling unit structural base.
2. Factory install structural supports for internal support casing if required to comply with casing structural performance.

2.10 CENTRIFUGAL PLENUM FAN ARRAYS

A. Operating Performance:

1. Air-handling unit manufacturer shall account for, and include in, submitted fan selections any static pressure drops associated with unit, and system effect due to fan operating in the air-handling unit.
2. Fans shall have sharply rising pressure characteristics at operating point and stable in operation.
3. Fan speed, brake horsepower, and sound power levels indicated are maximum acceptable.
4. Scheduled motor horsepower, airflow rate, and static pressure are minimum acceptable.

B. Vibration Balance:

1. Each fan/motor assembly shall be factory balanced to AMCA 204, BV-3, Balance Quality Grade G6.3 or better through entire operating speed range from minimum speed to maximum speed.
2. Identify and record each speed and speed range within the fan operating range that could cause potential vibration problems.
3. Submit test reports as an informational submittal for Project record.

C. Vibration Isolation: Install vibration isolation on each fan/motor assembly in the fan array.

D. Operation and Service Requirements:

1. Remaining fans in array shall continue to operate with one or multiple failed fans.
2. Each fan/motor assembly of fan array shall be capable of lock-out/tag-out procedure without interrupting operation of other fans in the array.
3. Each fan/motor assembly shall be controlled through a dedicated variable-frequency controller.
4. A single mechanical, electrical, and control device failure shall not result in a fan array available capacity of less than 90 percent of air-handling unit total scheduled airflow capacity.
5. Fan wheel/motor assembly shall pass through the air-handling unit access door servicing fans. Entire individual fan assembly shall pass through the door to the room where air-handling unit is located.

E. Airflow Measurement Remote Monitoring:
1. Piezometer Ring: Mount at fan inlet cone for airflow measurement.
2. Airflow measurement instrumentation shall not restrict or deflect air travel through fan and shall not impact fan air and sound performance.

3. Include a 4- to 20-mA output signal for remote monitoring of total fan array airflow.

F. Fan Array Remote Control:

1. Include fan control panel with control interface for remote control.
2. Fan array on/off operation shall be remotely controlled through a single hardwired digital output signal.
3. Fan array speed shall be remotely controlled through a single hardwired analog (4- to 20-mA) output signal.

G. Fan Base, Stackable Fan Units:

1. Mount fan/motor on aluminum base.
2. Include base and vibration isolators in accordance with requirements indicated.
3. Size and design the base construction to withstand the rigors of shipping and rigging.
4. Include the base with lifting lugs or holes.

H. Fan Frame:
1. Reinforce and brace frame to prevent excessive deflection and pulsation.
2. Include stiffeners to form a rigid frame that is free of structural resonance and vibration.

I. Fan Inlet Cone:

1. Include a precision-spun or die-formed, matched inlet and wheel cone to ensure streamlined airflow into the wheel and full loading of fan blades.
2. Inlet cone shall be a smooth hyperbolic shape.
3. Inlet cone shall be a single piece, constructed of aluminum or powder-coated steel.
4. Fasten inlet cone to fan panel using bolts, nuts, and washers to provide a positive and secure attachment that can be field removable.

J. Fan Wheel:

1. Fan blades shall be a true hollow airfoil shape, welded to backplate and wheel cone.
2. Construct blades of aluminum, reinforced for AMCA fan class.
3. Design blades to provide smooth airflow over all surfaces of blade.
4. Construct fan hubs of aluminum with integral bracing for extra strength and stiffness.

    a. Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters, or other similar injurious defects.
    b. Clean surfaces of castings by blasting, pickling, or any other standard method.
    c. Mold-parting fins and remains of gates and risers shall be chipped, filed, and ground flush.
    d. Design hubs to maintain a high resistance to fatigue and low relative wheel imbalance.

5. Hubs shall be keyed and set-screwed to motor shaft for positive attachment.
6. Construct wheel backplates of aluminum.

K. Fan Drive:

1. Direct drive, arrangement 4 in accordance with AMCA 99.

2. Adjust wheel width and diameter to match motor speed while providing performance scheduled.
3. Fasten fan wheel directly to motor shaft using a key in motor shaft and setscrew.

L. Fan Enclosure:

1. Include each fan in fan array with integral single-wall enclosure constructed of solid aluminum sheet.
2. Enclosure shall not increase fan array length beyond size indicated on Drawings.
3. Enclosure shall not add static pressure loss.
4. Enclosure shall provide a physical separation between operating adjacent fans to prevent negative performance.

M. Backdraft Damper:

1. Include each fan in the fan array with a backdraft damper at the fan outlet to prevent air circulation through a fan that is not operating.
2. Open backdraft damper when fan is operating and close when fan is not operating.
3. Design backdraft damper assembly to operate with little to no static pressure loss with fan operating throughout entire operating range from design to minimum airflow.

    a. Add damper pressure loss to fan scheduled total static pressure.

4. Fasten backdraft damper assembly to fan panel or enclosure using hardware designed for easy removal by maintenance personnel.
5. Dampers shall not create measurable additional noise above the sound level of fan.
6. Dampers shall not vibrate or rattle.
7. Construct dampers of extruded aluminum, stainless steel, or powder-coated steel.

N. Nameplates:

1. Construct nameplates and rotation arrows of aluminum or 300 series stainless steel.
2. Securely fasten nameplate and rotation arrow to fan housing using pins or sheet metal screws.
3. Locate nameplates in a highly visible location on motor side of fan.
4. Include the following information on nameplate:

    a. Manufacturer.
    b. Manufacturer model number.
    c. Serial number.
    d. Manufacturing date.
    e. Fan size.
    f. Design airflow.
    g. Design static pressure.
    h. Design fan speed.
    i. AMCA fan class.

O. Air-Handling Unit Factory Assembly:
1. Removal and Replacement: Each fan wheel and motor shall be independently removable and replaceable through a removable access door installed in air-handling unit casing.
2. Panel-Mounted Fan Array Supports:

a. Construct a freestanding and self-supporting structural framework to support each fan individually from and independent of adjacent fans.
b. Construct frame work from aluminum or stainless steel.

2.11 FAN MOTORS

A. Source Limitations: Obtain motors from single source from single manufacturer.

B. Description: NEMA MG 1, Design B**,** as required to comply with capacity and torque characteristics; medium-induction motor.

1. Performance:

a. 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.
b. Efficiency: NEMA Premium Efficiency rating complying with NEMA MG 1.
c. Motor Horsepower: Minimum size as indicated on Drawings. Motor shall operate fan under all conditions indicated without exceeding motor nameplate and without use of motor service factor.
d. Inverter-Duty Rating: Comply with minimum requirements of Class F or Class H insulation, suitable for "inverter-duty" or "drive-duty" applications in accordance with NEMA MG 1. Motor operation through a variable-frequency controller shall not adversely affect the motor performance, operation, useful life, and warranty.
e. Service Factor: 1.15

C. Enclosure Type: TEFC.

D. Shaft Grounding System:

1. Shaft grounding system to protect bearings from induced voltage.
2. Shaft grounding system shall have low drag (less than 0.05 percent of motor horsepower), and shall operate for a minimum of three years without periodic maintenance or adjustments.
3. Mounting: External to motor enclosure.

E. Frame:

1. Frames with integrally cast feet unless other requirements of driven equipment require a different arrangement.
2. Frame, front and back end brackets, and front and back end bearing intercaps constructed of cast iron, ASTM A48/A48M, Class 25 or better.

F. Rotor:

1. Fabricate rotor frame from die-cast aluminum, copper, or associated alloys.
2. Key rotors to motor shaft.
3. Rotating assembly shall be dynamically balanced to within limits defined in NEMA MG 1.
4. Motors shall have the entire rotating assembly between bearing inner caps coated with a corrosion-resistant coating.

G. Stator:

1. Copper windings shall be spike resistant to withstand 1600 peak V.
2. Entire wound and insulated stator coated with a coating to protect against moisture and corrosion.

H. Shaft:

1. Solid shaft fabricated of carbon steel, accurately turned, ground and polished, and inspected for accuracy.
2. End of shaft with drilled hole for use in field measurements.

I. Bearings:

1. Grease-lubricated ball or roller bearings.
2. Bearing Lubrication:

   a. Factory lubricate motor bearings using a premium moisture-resistant polyurea thickened grease with rust inhibitors suitable for extreme operating temperatures encountered.
   b. Coordinate special requirements that may impact lubrication and include appropriate lubrication.

3. Grease Fittings:

   a. Equip each bearing housing with an easily accessible grease inlet.
   b. Fit grease inlets with a grease fitting and protective fitting cap.
   c. Equip inlets with an automatic grease relief fitting to prevent excessive greasing.
   d. Equip each bearing housing with grease drain and threaded plug.

J. Conduit Box:

1. Material same as frame.
2. For motor frames 365T and below, furnish conduit boxes sized with internal volumes in accordance with NEMA MG 1.
3. For motor frames larger than 365T, furnish conduit boxes one size larger than NEMA MG 1.
4. Coordinate the location and mounting of conduit box with driven equipment manufacturer.
5. Factory mount conduit box on motor.

K. Grounding: NRTL-listed clamp-type grounding lug mounted in conduit box.

L. Motor Leads:

1. Non-wicking type, Class F temperature rating or better, and permanently numbered over entire length for identification.
2. Lead terminals shall be manufacturer's standard.

M. Condensate Drains:

1. Motor with drain holes at the lowest point for drainage of condensate.

2. Each drain hole with a threaded removable plug..

N. TEFC Motor Fans: Corrosion-resistant construction, non-sparking, metallic or non-metallic, bi-directional, and keyed to shaft.

O. Lifting Eyebolts: Eyebolt threaded into frame receptacle and designed to prevent moisture and other foreign material from entering motor cavity when eyebolt is removed.

P. Nameplates:

1. Construct nameplates of aluminum or stainless steel and attach to motor frame with aluminum, stainless steel, or brass drive pins.
2. Engrave or stamp data on the nameplate.
3. At a minimum, include nameplate data in accordance with NEMA MG 1.

2.12 VIBRATION ISOLATION

A. General:

1. Provide fans inside air-handling units with vibration isolation.

B. Spring Isolators:

1. Performance:

a. Deflection: 2-inch minimum. Use a greater deflection if required to maintain an isolator efficiency of at least 98 percent under all operating conditions encountered. Calculate isolator efficiency using actual support conditions considering the rigidity of structure.
b. Laterally stable freestanding open-spring mounting.
c. Spring diameter not less than 0.8 of compressed spring height at rated load and in the installed and operating condition.
d. Reserve travel to solid shall be equal to a minimum of 50 percent of rated deflection and in no case less than 25 percent of rated deflection in an installed and operating condition.
e. Ratio of horizontal stiffness to vertical stiffness equal to approximately one.
f. Design and install so that ends of springs remain parallel.
g. Select springs that are non-resonant with equipment related frequencies and natural frequencies of support structure.
h. Springs shall not take a permanent set when compressed to coil bind.
i. Seismic restraints to limit motion under seismic forces to 1/4 inch.

2. Construction:

a. Coat springs with PVC or neoprene. Color-code springs to allow positive identification after installation.
b. Isolators with integral leveling bolts.
c. Baseplates with holes and isolation grommets for bolting.

C. Elastomeric Grommets:

1. Elastomeric grommets shall be a combination of neoprene washer and bushing.
2. Elastomer shall be 56-durometer maximum.
3. Grommets formed to prevent bolts from directly contacting the secured item.

D. Flexible Connections:

1. Construct flexible connection edges firmly attached to waterproof and fire-retardant fabric.
2. Suitable for operation in extreme temperatures encountered.
3. NRTL listed for application and complying with NFPA 90A.

E. Air-Handling Unit Factory Assembly:
1. Install spring isolators plumb and adjust isolators that are not plumb under operating conditions to make plumb.
2. Adjust isolators to prevent stress transfer to equipment.
3. Verify that installed isolators and mounting systems permit equipment motion in all directions.
4. Adjust or include additional resilient restraints to flexibly limit fan lateral motion to 1/4 inch during startup and operation of equipment.
5. Anchor restraints to fixed supports having a stiffness greater than the thrust encountered.
6. Include at least 2-inch operating clearance between fan bases and walking surface of air-handling unit floor. Before startup, clean out foreign matter between bases and equipment to prevent short circuit.
7. Flexible Connections:

a. Install flexible connections at connections to fans.
b. Install flexible connections in accordance with SMACNA standards and manufacturer's written instructions.
c. Make fabric joints on the flat run, not the corners, with overlap to provide an area sufficient to make a positive seal.
d. Apply adhesive between the fabric layers.
e. Attach connections using screws or bolts.
f. Reinforce fabric if required to keep fabric from collapsing and impacting airflow into fan.

2.13 HYDRONIC COILS

A. General: Provide air-handling units with hydronic coils where indicated on Drawings.

B. Description: Plate fin coils constructed of staggered tubes mechanically expanded into continuous collars that are die formed into plate fins.

C. Design and Performance:

1. Capacities, face area, and number of rows indicated on Drawings are minimum acceptable.
2. Air pressure drop, water pressure drop, fin spacing, and face velocity indicated on Drawings are the maximum acceptable.
3. Coils shall be counterflow design, air to fluid. Fluid supply shall enter air leaving side of coil and exit air entering side.

4. Design coils to be drainable.

    a. Coils shall have all circuits drainable when coils are installed in horizontal position and level.
    b. Coil supply header shall be furnished with a drain connection at lowest point on header.

5. Design coils to be self-venting.

    a. Supply connection near bottom of supply header.
    b. Return connection near top of return header.
    c. Furnish coil return header with a vent connection at highest point on header.

6. Coils supply and return piping connections on same end of coil.
7. Coils shall be rated for system operating pressures and temperatures encountered by installation, but not less than 150 psig.
8. Coil selection criteria, unless otherwise indicated on Drawings, are as follows:

    a. Face Velocity: Maximum of 350 fpm.
    b. Fluid Header Velocity: Maximum of 6 fps.
    c. Fin Height: Maximum of 40 inches.
    d. Fin Spacing: Maximum of 12 fins per inch.

9. Cooling coils shall have no moisture carryover at design conditions. Install moisture eliminators on discharge face of coil if it is necessary to eliminate moisture carryover.

D. Casing and Tube Sheets:

1. Depth: Extend coil casing and tube sheets a minimum of 1/2-inch beyond face of fins on both entering and leaving sides.
2. Casing and Tube Sheet Materials:

    a. Cooling and Heating Coils: Stainless steel, ASTM A240 or ASTM A480, Type 304L, No. 2D finish.

3. Tube Sheets:

    a. Tube sheet holes rolled to prevent chaffing of tubes during thermal expansion and contraction.

4. Holes: Include number, size, and location of holes in casing and end tube sheets required for coil installation.

E. Fins:

1. Materials: Aluminum: 0.0075 inch thick.
2. Collars: Full collars for accurate fin spacing and maximum tube contact while leaving no surface of tube exposed.

F. Headers:

1. Construct header of seamless copper, ASTM B75/B75M drawn temper of diameter and wall thickness based on coil size, flow rate, design pressure, design temperature, and circuiting.
2. Drains: Include low point of supply header with a NPS 1/2 drain connection. Extend copper pipe through air-handling unit casing and terminate end with male national pipe thread (MNPT). Pipe shall be threaded on both ends to facilitate easy field removal and replacement.
3. Vents: Include high point of return header with a NPS 1/2 vent connection. Extend copper or pipe through air-handling unit casing and terminate end with MNPT. Pipe shall be threaded on both ends to facilitate easy field removal and replacement.
4. Supply and Return Connections:

    a. Terminate ends with MNPT.
    b. Connections shall have a bronze ASME 16.24 threaded flanges attached to threaded connections to provide for a Class 150 flanged field connection.

5. Protect openings of supply, return, vent, and drain connections with a threaded cap to prevent entry of dirt into the coil.

G. Tubes:

1. Material: Copper, ASTM B75/B75M annealed temper or ASTM B280 drawn temper.
2. Tube Nominal Wall Thickness: As required by performance, minimum of 0.020 inch thick.

H. Tube Return Bends: 180-degree bends brazed to tubes; material, and nominal diameter to match tubes.

I. Brazing: High-temperature brazing alloy with not less than 5 percent silver when brazing like non-ferrous materials together and more than 30 percent silver when brazing ferrous to non-ferrous materials.

J. Coatings: Coat coils with one of the following coatings for additional corrosion protection:

1. Baked phenolic.
2. Cathodic epoxy.
3. Water-based flexible epoxy polymer.
4. Water-based synthetic flexible polymer.

K. Cleaning: Residual manufacturing oils and solid contaminants shall be removed internally and externally by completely submersing the coil in an environmentally acceptable degreasing solution that is chemically compatible with the coil material.

L. Air-Handling Unit Factory Assembly:

1. Coil Connections: Extend each coil connection through casing access panel and terminate connections, approximately 3 inches beyond exterior face of access panel, and seal each penetration. Casing access panels shall be removed and reinstalled with coils installed inside air-handling units.
2. Removal and Replacement: Each coil shall be independently removable and replaceable through a removable access panel installed in air-handling unit casing.
3. Supports for Coils:

a. Construct a freestanding and self-supporting structural framework to support each coil individually from and independent of adjacent coils.
b. Construct framework for cooling coils, from stainless steel
c. Construct frame work for heating coils from aluminum or stainless steel.

2.14 DRAIN PANS

A. General:

1. Include a drain pan for each cooling coil.
2. Continuously weld drain pan seams, joints, and mitered corners to make the assembled drain pan watertight.
3. Drain pans shall be located under the entire coil and provide full coil coverage including coil return bends and headers.
4. Slope drain pans in multiple directions toward low point drain connection at a uniform slope of at least 1 percent from high point to low point.
5. Include stainless steel blank-offs to prevent air from bypassing around coil.

B. Intermediate Drain Pans:

1. Where multiple individual horizontally mounted coils are vertically stacked to make a coil bank, install intermediate drain pans under each stacked coil in the coil bank.
2. Material: Type 304L stainless steel ASTM A240 or ASTM A480, a minimum of 16 gauge thick.
3. Minimum Depth: 1 inch.
4. Extend drain pan beyond air entering face of coil casing at least 2 inches.
5. Extend drain pan beyond air leaving face of coil casing at least 6 inches.

6. Drain Pan Connection:

a. Stainless steel threaded coupling welded to underside of drain pan at lowest point.
b. Minimum Nominal Connection Size: NPS 1.

7. Drain Pipe:

a. Air-handling unit manufacturer to connect full-size drain pipe to each drain pan connection. Option to use one of following pipe materials:

1) Copper tube with a bronze threaded male adapter, brazed or solder to end.
2) Stainless steel pipe with threaded MNPT ends.

b. Extend drain pipe to top of drain pan immediately below.
c. Include a removable stainless steel support to secure bottom of drain pipe from drain pan below to prevent lateral movement.

C. Bottom Drain Pans:

1. Mounting Location, Recessed in Floor: Air-handling unit manufacturer has option to recess bottom drain pan into the floor or install drain pan above air-handling unit floor walking surface.
2. Extend drain pan beyond air entering face of coil casing at least 3 inches.

3. Extend drain pan beyond air leaving face of coil casing at least 12.

4. Drain Pan Connection:

   a. Stainless steel threaded half-coupling welded to lowest point of drain pan.
   b. Location: One end.
   c. Minimum Nominal Connection Size: NPS 1.5.

5. Drain Pipe:

   a. Air-handling unit manufacturer to connect full size drain pipe to each drain pan connection. Option to use one of following pipe materials:

      1) Copper tube with threaded male adapter, brazed or soldered to ends.
      2) Stainless steel pipe with threaded MNPT ends.

   b. Extend drain pipe and terminate 3 inches beyond exterior face of casing.

2.15 RIGID BOX CELL FILTERS

A. Source Limitations: Obtain filters from single source from single manufacturer.

B. Description: Rigid box cell, disposable, air filters.

C. Performance:

1. Filtration Efficiency, ASHRAE 52.2 MERV Rating: 14.

D. Certification:

1. AHRI: Tolerances in accordance with AHRI 850.
2. ASHRAE: Tested and rated in accordance with ASHRAE 52.2.
3. UL: UL 900 listed.

E. Size:

1. Nominal size of individual filters indicated on Drawings:
2. Nominal Filter Size:

   a. Face: 24 x 24 inches or 12 x 24 inches
   b. Depth: 12 inches.

2.16 PLEATED PANEL FILTERS

A. Source Limitations: Obtain filters from single source from single manufacturer.

B. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters.

C. Performance:

1. Filtration Efficiency, ASHRAE 52.2 MERV Rating: 8.

D. Certification:

1. AHRI: Tolerances in accordance with AHRI 850 (I-P) and AHRI 851 (SI).
2. ASHRAE: Tested and rated in accordance with ASHRAE 52.2.
3. UL: UL 900 listed.

E. Size:

1. Nominal size of individual filters indicated on Drawings:
2. Nominal Filter Size:

a. Face: 24 x 24 inches or 12 x 24 inches.
b. Depth: 2 in.

2.17 ASHRAE-RATED FILTER HOLDING FRAMES

A. Air-Handling Unit Factory Installation:

1. Air-handling unit manufacturer shall furnish filters and provide filter holding frames, retaining clips, and filter support structures.
2. Frames shall be suitable for supporting and holding both pre-filter and final filters in frame.
3. Gaskets: Continuous, suitable for same operating temperature as filters.
4. Filter Clips: Each filter holding frame with spring clip fasteners at each corner. Spring clips shall allow filters to be removed and replaced without use of tools.
5. Frames shall be industry-standard size to provide interchangeability of filters from other manufacturers.
6. Furnish filter quantity, size, type, and performance indicated on Drawings.
7. Install filter frames in a flat vertical position for horizontal airflow.
8. Install holding frames in accordance with manufacturer's written instructions and to prevent passage of unfiltered air. Include additional gaskets as necessary.
9. Secure individual holding frames together to build a multiple filter bank.
10. Construct galvanized steel support structure to hold frames and filters.

a. Design support structure for maximum system operating pressures encountered equal to fan shutoff pressure.

2.18 FILTER GAUGES

A. Basis-of-Design Products: Subject to compliance with requirements, provide the following:

1. Gauge: Dwyer 2001 for pre-filter and Dwyer 2002 for final filter, or approved equal.

B. Provide a gauge to indicate pressure differential between entering and leaving side of each filter bank. Panel filter bank separate from cartridge filter bank.

1. Where multiple filters share a common frame, include a separate gauge for each filter bank.

2. Include a metal spacer constructed of same material as filter frame for one of the filters installed in filter bank to accommodate pressure differential measure across both upstream and downstream filters.

C. Gauge shall have a nominal 4-inch-diameter face.

D. Select range of gauge to be approximately twice the dirty filter pressure drop.

E. Provide each gauge with vent valves to allow for re-zeroing the gauge without removing tubing connections.

F. Include static pressure sensors on entering and leaving side of each filter bank.

G. Air-Handling Unit Factory Assembly:

1. Mount each filter gauge on exterior surface of unit casing near associated filter sections.
2. Connect static pressure sensors to filter gauges using copper tubing and compression type fittings.
3. Support tubing at intervals not greater than 60 inches o.c.

2.19 AUTOMATIC DAMPERS

1. Dampers shall be opposed-blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers with Aluminum Blades:

1. Source Limitations: Obtain dampers from single source from single manufacturer.

2. Smoke Rated Dampers.
   a. Supply and return dampers shall be rated smoke dampers.
   b. Performance:
      1) Leakage: In accordance with UL 555S, Class 1.
      2) Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, figure 5.3.
      3) Temperature: 250 deg F.
      4) Pressure Rating: 8.0 inches wg.

3. Performance of Non-Smoke Rated Dampers:

   a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
   b. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, figure 5.3.
   c. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
   d. Damper shall have AMCA seal for both air leakage and air performance.

4. Construction:

a. Frame:

1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
2) Width not less than 4 inches.

b. Blades:

1) Hollow, airfoil, extruded aluminum.
2) Material: ASTM B211, Alloy 6063 T5 aluminum.
3) Width not to exceed 6 inches.
4) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.

d. Axles: Minimum 0.5-inch diameter, plated steel, mechanically attached to blades.

e. Bearings:

1) Molded synthetic or stainless steel sleeve mounted in frame.
2) Where blade axles are installed in vertical position, include thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated steel.
3) Hardware: Stainless steel.

C. Damper Actuators:

1. General:

a. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which damper is subjected.
b. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
c. Total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
d. Include one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
e. Avoid use of excessively oversized actuators, which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
f. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

g. Include mounting hardware and linkages for connecting actuator to damper.
h. Select actuators to fail in desired position in the event of a power failure.

1) Relief Air: Close
2) Outdoor Air: Close.
3) Supply Air: Open.
4) Return Air: Open.

2. Type: Motor operated, with or without gears, electric and electronic.

3. Construction:

a. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
b. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
c. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

4. Field Adjustment:

a. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
b. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when actuator is not powered.

5. Modulating Actuators:

a. Capable of stopping at all points across full range, and starting in either direction from any point in range.
b. Control Input Signal:

1) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation.
2) Programmable Multifunction:

a) Control input, position feedback, and running time shall be factory or field programmable.
b) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
c) Service data, including at a minimum, number of hours powered, and number of hours in motion.

6. Position Feedback:
a. Equip modulating actuators with a position feedback through current signal for remote monitoring.
b. Include a position indicator and graduated scale on each actuator indicating open and closed travel limits.

7. Fail-Safe:

a. Where indicated, provide actuator to fail to an end position.
b. Internal spring return mechanism to drive-controlled device to an end position (open or close) on loss of power.

8. Integral Overload Protection:

a. Provide against overload throughout the entire operating range in both directions.
b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

9. Damper Attachment:

a. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
b. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
c. Bolt and set screw method of attachment is acceptable only if included with at least two points of attachment.
d. NEMA 250, Type 2 for all applications.

10. Actuators operating in smoke-control systems shall comply with governing code and NFPA requirements.

11. Sound:

a. Spring Return: 62 dBA.

2.20 DUCT SILENCERS

1. Duct Silencer Sourcing Option: In lieu of sourcing duct silencers from a specialty duct silencer manufacturer, air-handling unit manufacturer has option to furnish in-house silencers that achieve equal or better performance while complying with other requirements indicated.

a. Full-height duct silencers baffles shall span from floor to roof of air-handling unit air tunnel and consist of multiple baffles aligned to fill the entire cross-sectional area of air-handling unit air tunnel. In this alternative, the air-handling unit casing shall serve as the duct silencer casing.

B. General: Air-handling unit manufacturer shall furnish and install duct silencers and associated support structures inside air-handling units.

1. Select face area of silencers to fill the entire cross-sectional area of air-handling unit air tunnel.
2. Factory fabricated.
3. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials with flame-spread index not exceeding 25 and smoke-developed index not exceeding 50; ASTM E84.
4. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

C. Ratings and Performance:

1. Duct silencer manufacturer shall publish performance for dynamic insertion loss (DIL), self-noise power levels, and airflow static pressure loss based on results of performance testing indicated.
2. Duct silencer manufacturer shall test duct silencers in accordance with ASTM E477 in a qualified nationally recognized independent testing laboratory or manufacturer's National Voluntary Lab Accreditation Program-accredited laboratory.

    a. Conduct tests with air flowing through duct silencers at not less than three different flow rates and with no airflow.
    b. Test methods shall eliminate effects due to end reflection, vibration, flanking transmission, and standing waves in the test chamber.
3. Silencer self-generated noise shall not increase system sound level.
4. Static pressure loss not to exceed values indicated on Drawings.

D. Construction: Fabricate rectangular silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for individual unit assemblies.

1. Casing:

    a. Unless otherwise indicated, construct outer casing in accordance with ASHRAE and SMACNA standards for construction of high-pressure rectangular ductwork.
    b. Casing seams and joints shall be lock formed and mastic filled, or continuously welded.
    c. Materials and Thickness:

        1) Galvanized Steel, ASTM A653/A653M, G90 Finish:

            a) Outer Casing: Solid, minimum 20 gauge thick.
            b) Baffles: Perforated, minimum 24 gauge.

2. Dissipative-Type Duct Silencer Fill Materials:

    a. Inert, vermin-proof, and moistureproof inorganic mineral or glass fiber of a density sufficient to obtain the acoustic performance indicated. Fiber-free fill materials are an acceptable alternative..
    b. Fill material and coverings shall not exceed the following values when tested in accordance with ASTM E84, NFPA 255, and UL 723:

        1) Flame-Spread Index: 25.
        2) Smoke-Developed Index: 50.
        3) Fuel Contribution: 20.

    c. Protective Coverings for Fiber Fill Materials:

        1) Completely cover silencer fiber fill materials with a protective covering, such as a tightly woven fiberglass fabric, to prevent particle contamination of airstream without degrading silencer acoustical performance.

E. Factory Assembly:

1. Install duct silencers in correct direction with respect to airflow.

2. Manufacturer's written installation instructions shall not be compromised.
3. Seal penetrations through duct silencer baffles using a sealant.
4. Install duct silencers with baffles oriented in the vertical position.
5. Duct silencer banks consisting of multiple individual duct silencers shall be as follows:

    a. Structurally reinforced to support loading and limit deflection to 1/200 of span.
    b. Provided with a continuous nosing to cover all joints of adjoining duct silencers. Nosing shall be constructed of same material as duct silencers and attached by friction fit, crimping, or button punch.

F. Cleaning:

1. After assembly, clean duct silencers with HEPA-filtered vacuum machines and then wipe all surfaces with a cleaning agent, using clean rags.

2.21 ANTIMICROBIAL ULTRAVIOLET (UV) LAMP SYSTEMS

A. Description: UV-C lamp system consisting of power supply, wiring, lamp(s), plug(s), and holder(s) used for ultraviolet germicidal irradiation (UVGI) of cooling coil and condensate drain pan.

B. AHU manufacturer is responsible for UVC lamp mounting structure, attachment methodology of lamp structure to AHU, placement space allowance for lamp distances to coil in accordance with UVC lamp schedule, and coordination with AHU internal construction such as cooling coils, drain pans, and up-stream sections requiring UV protection and access.
1. UVC vertical lamp mounting structure shall be shipped loose with AHU connection hardware. Quantity of verticals shall assume 48” bulb lengths across full width of unit. Final placement and securement of verticals within AHU shall be coordinated with UV-C system supplier.
2. AHU manufacturer to provide penetration detail and methodology for eventually UV-C system electrical power penetration to internally mounted bulbs.

C. Location: UV-C lamp system space allocated at locations indicated on Drawings.

D. UV-C Lamp System Support Assembly: Aluminum or 300 series grade stainless steel framework rigidly attached to air-handling unit casing and adequately braced to pro-vide ridge support of UV-C lamp systems that will not move or damage when leaned on or bumped into by operators.

E. Service Access: Lamps shall be easily replaceable from inside the air-handling unit.
1. Install access door(s) with window to access UV light. Treat each window and test to confirm UV emitted through the window is below the threshold limits of NIOSH and ACGIH.
2. In addition to disconnecting switch, provide each access door accessible to UV-C lamp systems with a position limit switch wired into UV-C lamp systems power circuit to de-energize power to UV-C lamp systems when door is opened.

F. Install a caution nameplate at each UV-C lamp system disconnecting switch that reads: "DANGER, UV LIGHTS - Turn off before entering."

G. Protection from UV Damage: Materials in direct or indirect (reflected) contact with UV shall be tested and certified as UV tolerant. Any material not certified shall be completely shielded from

UV using a certified UV-tolerant material such as metal. UV tolerance shall be capable of performing intended duty for a minimum of 20 years.

H. UVC system lamp selection, quantities, intensities, vertical spacing, dosing calculations, controls etc. to be provided by others.

I. AHU manufacturer to define lamp securement methodology to vertical structure (standardize for wide industry lamp selection compatibility) and coordinate information with UVC system installer.

J. AHU manufacturer to provide AHU related safeties including door viewing glass protection, door opening switches, and cable penetration methodology.

K. UVC System control panels and ballast panels to be installed external to the AHU.

L. Refer to UVC specification and equipment schedules for full system requirements.

2.22 AIR-HANDLING UNIT FACTORY DRAIN PIPING AND PIPING INSULATION

A. General:

1. Air-handling unit manufacturer to factory install piping inside air-handling units.

B. Copper Tubing:

1. Tubing: Drawn temper, ASTM B88, Type M.
2. Fittings: Wrought-copper and copper-alloy, ASME B16.22, pressure fittings.
3. Unions: Cast-copper-alloy, MSS SP-123, hexagonal-stock body; female NPT threaded ends
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux in accordance with ASTM B813.

C. Drain Pan Piping:

1. Copper tube with soldered threaded male adapters.
2. Factory install drain piping for drain pan(s).
   a. Terminate pipe with a threaded pipe cap 3 inches beyond exterior face of air-handling unit casing. Threaded pipe cap material to match pipe material.
   b. Drain pipe size to match size of drain pan connection.

D. Piping Insulation:

1. Factory insulate bottom cooling coil drain pan pipe with 1/2-inch thick, flexible elastomeric insulation where pipe is located under and outside of the air-handling unit casing but within the air-handling unit base.
2. Cover pipe insulation with a factory-applied aluminum or stainless steel jacket.
3. Insulation exposed to UV light shall be capable of performing intended duty for a minimum of 20 years.

2.23 FACTORY ASSEMBLED ELECTRICAL

A. Factory install service light fixtures and switches, and receptacles for each air-handling unit.

1. Locate in a convenient and field-accessible location.
2. Installation shall comply with NFPA 70.
3. Wire, Conduit, and Enclosures:

a. Minimum Conduit Size: 3/4 inch.
b. Materials: Metal, with a corrosion-resistant finish.
c. Supports: Support conduits, boxes, and enclosures using corrosion-resistant fastening hardware.
d. Conduit: Locate conduit inside the air-handling unit casing. Conduit installed on exterior of air-handling unit casing is unacceptable.
e. Wire:

1) Copper, rated for 600 V, solid wire for size No. 10 AWGa nd smaller and stranded wire for larger sizes.
2) Minimum Wire Size: No. 12 AWG.
3) Each circuit shall have a ground wire.
4) Install wire in conduit.

f. Boxes, Conduit Outlet Bodies, and Enclosures:

1) Located in Airstream: NEMA 250, Type 4.

g. Seals: Seal pathways to prevent air leakage between air-handling unit exterior and interior, and between internal component sections.
h. Service Lighting Applications:

1) Provide quantity of 20-A branch circuits required to power service light fixtures.
2) Factory install a power junction box for interfacing air-handling power for service lighting with single-point field power wiring connection.

i. Receptacle Applications:
1) Factory wire receptacles to a field power junction box for interfacing air-handling power for receptacles with a single-point field power wiring connection.

B. Field Power Junction Box: Factory-install junction box with internal wire terminal block mounted on air-handling unit casing exterior for interface of factory power wiring with field power wiring.

C. Service Light Fixtures:

1. Vaportight Fixtures:.
a. Suitable for wet locations and operation in cold- and hot-temperature extremes encountered; dust and moisture resistant.
b. Cast aluminum housing and guard with heat-resistant, tempered, clear glass globe.
c. Light fixture to have a glass globe and a wire or cast guard. Light sockets shall be porcelain, medium base. Light fixture compatibility for universal voltage 120-277V
d. LED A21 Series Lamps:

1) Light Color: 5000 K.
2) Light Output: 1100 lumens.

2. Application: Provide one service light fixture in each accessible section of air-handling units.

D. Toggle Switches for Service Light Fixtures:

1. Single-Pole Switches, 120/277 V, 20 A: Comply with UL 20 and FS W-S-896.
2. Toggle Switch Box and Cover: Mount toggle switch in a metal outlet box with cast-aluminum or stainless steel cover.
3. Application: Factory install service light switches at locations indicated on Drawings.

E. Receptacles:

1. Duplex GFCI Receptacles, 125 V, 20 A:

a. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
b. Configuration: NEMA WD 6, Configuration 5-20R.
c. Type: Non-feed through.
d. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2. Receptacle Box and Cover: Mount receptacle in a metal outlet box with cast-aluminum or stainless steel cover.
3. Applications: Factory install a receptacle in a convenient and field-accessible location on air-handling unit exterior of casing at locations indicated on Drawings.

F. Power Supply to Fan Motors: Furnish one (1) variable-frequency controller per fan motor.

G. Variable-Frequency Controllers:

1. Description: NEMA ICS 2; arranged to achieve motor variable speed by adjusting output voltage and frequency.
2. Enclosure: NEMA 250, Type 12 with hinged full-front access door with lock and key.
3. Externally Operated Disconnect: Fused disconnect switch with lockable handle.
4. Minimum Short-Circuit Current Rating: As required by electrical power distribution system, but not less than 42,000 A.
5. Technology: Pulse-width-modulation (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.
6. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.
7. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.
8. Output signal shall be programmed to not cause mechanical vibration issues with fan drive assembly.
9. Operating Requirements:

a. Input AC Voltage Tolerance: Plus/minus 10 percent input voltage rating.
b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
c. Capable of driving full motor load, without derating.
d. Minimum Efficiency: 96 percent at 60 Hz, full load.
e. Minimum Displacement Primary-Side Power Factor: 95 percent.

f. Overload Capability: 1.05 times the full-load current for 7 seconds.
g. Starting Torque: As required by fan and motor drive assembly.
h. Speed Regulation: 1 percent.
i. Speed Range: 10:1 speed range.
j. To avoid equipment resonant vibrations, include critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.
k. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.

10. Controller Adjustability Capabilities: Minimum and maximum output frequency, acceleration and deceleration, and current limit.
11. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or need for replacement:

a. Surge suppression.
b. Loss of input signal protection.
c. Critical frequency rejection.
d. Overtemperature.
e. Short circuit at controller output.
f. Ground fault at controller output. Variable-frequency controller shall be able to start a grounded motor.
g. Open circuit at controller output.
h. Input undervoltage.
i. Input overvoltage.
j. Loss of input phase.
k. Reverse phase.
l. AC line switching transients.
m. Instantaneous overload, line to line, or line to ground.
n. Sustained overload exceeding 100 percent of controller rated current.
o. Starting a rotating motor.

12. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
13. Automatic Reset and Restart:

a. Capable of multiple restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.
b. Capable of automatic restart on phase-loss and overvoltage and undervoltage trips.

14. Visual Indication: On face of controller; indicating the following conditions:

a. Power on.
b. Run.
c. Overcurrent and overvoltage.
d. Motor speed (percentage).
e. Various faults with alarm status.
f. Input kilovolt amperes.
g. Power factor.
h. Input kilowatts and kilowatt-hours.
i. Three-phase input and output voltage.

j. Three-phase input and output current.
k. Output frequency.
l. Elapsed operating time (hours).
m. Diagnostic and service parameters.

15. Operator Interface: Start-stop and auto-manual selector with manual-speed-control potentiometer.
16. Remote Communication Interface: ASHRAE 135 BACnet MS/TP.
17. Line Conditioning:

a. Input line conditioning.
b. Output filtering.
c. EMI/RFI filtering.

18. Bypass Controller:

a. Bypass Controller/Variable-Frequency Controller Selector Switch: Include manual selector switch on face of enclosure for local operator control of preferred controller.
b. Bypass Mode: Field-selectable automatic or manual.

1) In automatic mode, include fail-safe control logic to automatically transfer fan motor operation from failed variable-frequency controller to bypass controller.

c. Type: Integrated NEMA ICS 2, Class A, full-voltage, non-reversing, motor-rated controller to operate fan motor if variable-frequency controller is not operational.
d. Arrangement: Configure power supply to bypass controller and variable-frequency controller to completely isolate power to variable-frequency controller while operating fan motor through bypass controller for safe servicing of variable-frequency controller.
e. Enclosure: Install bypass controller in same enclosure as variable-frequency controller.
f. Remote Monitoring: Include control relay for remote indication of bypass controller operation.

2.24 AHU CONTROLS

A. General:
1. AHU system controller
a. Provided by controls contractor, installed remote and adjacent to Air Handling Unit. Points of entry and continuation of control wiring to internally provided dedicated control conduit shall be included as part of AHU construction.
2. AHU provided control devices
a. AHU manufacturer shall provide the following control components integral to the AHU. The controls contractor will field install and connect all device control wiring as required to complete the sequence of operation:
1) All motorized dampers.
2) Fan airflow measuring stations.
3) Filter differential pressure taps.
3. AHU sensors, pressures, and miscellaneous measuring devices

a. The AHU manufacturer is responsible for ensuring that adequate physical space is available for the field installed sensors, pressure measurements, etc. done by the controls contractor. The controls contractor will mount and wire all devices as required by the control drawings and sequence of operation.

4. Identification
   a. All control and instrument wiring shall be identified with a unique wire number.
   b. These numbers shall agree with the numbers shown on the supplier's wiring diagrams. Control circuit wiring shall be permanently identified with wire markers applied within 1" of each terminal or connection.

B. Pitot Tube Airflow Stations:

1. Fan Inlet Airflow Sensor (Piezometer Ring):

   a. Source Limitations: Obtain sensors from single source from single manufacturer.
   b. Provide fans with airflow measurement integral to fan inlet cones for continuously measurement of air volume flow rate.
   c. Fan inlet airflow sensor shall contain multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.
   d. Sensor points shall neither protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
   e. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow.
   f. Sensor shall be non-intrusive and not impact fan performance.
   g. Product shall be a standard offering of fan manufacturer and include published literature with supporting test data to validate sensor performance.

C. Flow Transmitters for Pitot Tube Sensors:

1. Source Limitations: Obtain sensors from single source from single manufacturer.
2. Receives total and static pressure signals from a flow element, amplify, extract the square root, and scale the signal to produce a 4- to 20-mA dc output signal linear to airflow.
3. Housed in NEMA 250, Type 1 enclosure.
4. Assembly constructed so that shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter nor affect its accuracy.
5. Provide transmitter with an automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. Automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
6. Performance:

   a. Range: At least 20 percent below minimum airflow and 20 percent greater than design airflow.
   b. Calibrated Span: Field adjustable, minus 40 percent of the range.
   c. Accuracy: Within 0.10 percent of natural span.
   d. Repeatability: Within 0.15 percent of calibrated span.
   e. Linearity: Within 0.2 percent of calibrated span.
   f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.

7. Equip transmitter with an integral digital LED or LCD for continuous indication of airflow.

D. Checkout Procedures:

1. Check instruments for proper location and accessibility.
2. Check instruments for proper installation for direction of flow, elevation, orientation, and other applicable considerations.
3. Damper Check-out: Verify that proper blade alignment has been provided.

E. Calibration and Adjustment:

1. Calibrate every instrument.
2. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
3. Equipment and procedures used for calibration shall meet requirements of instrument manufacturer's written instructions. Test equipment used in calibration of instruments shall have an accuracy at least double that of instrument being calibrated.
4. Calibrate each instrument in accordance with the accuracy outlined in instruction manual supplied for instrument by manufacturer.
5. Control System Inputs and Outputs:

    a. Check analog inputs using a precision voltage or current source at zero, 50, and 100 percent of span.
    b. Check analog outputs using a milliampere meter at zero, 50, and 100 percent output.
    c. Check resistance temperature inputs at zero, 50, and 100 percent of span using a precision-resistant source.

6. Flow: Set differential pressure flow transmitters for zero and 100 percent values with three-point calibration accomplished at 100, 50, and 90 percent of span.
7. Dampers: Stroke and adjust control dampers following the recommended procedure from manufacturer, such that damper is 100 percent open and closed.
8. Replace out-of-tolerance instruments failing the test.
9. Provide diagnostic and test instruments for calibration and adjustment.

2.25 HARDWARE

A. Screws:
1. For Aluminum and Stainless Steel Materials: Self-tapping, hex-head, 300 series stainless steel screws with a neoprene gasket encapsulated by a 300 series stainless steel washer.
2. Provide protective covers on exposed screws to prevent personnel injury.

B. Bolts, Nuts, and Washers:
1. For Joining Aluminum and Stainless Steel Materials: Hex-head, high-strength, 300 series stainless steel.
2. Use washers and lock washers at each bolted connection.
3. Select bolt size and spacing sufficient for load and application.

2.26 WELDING

A. Welding Filler Metals: Comply with AWS welding codes for welding materials appropriate for thickness and chemical analysis of material being welded.

1. Use welding materials with corrosion properties equal to material being welded.

B. Use welders that are certified to weld at least twice the thickness of the material to be welded. Certification shall be within three months of work being performed.

C. Welds shall be continuous, full-penetration welds unless otherwise indicated. Intermittent welds, stitch welds, and tack welds are permitted only in specific applications indicated.

D. Use welders and welding procedures complying with the following:

1. Piping Systems: Section IX of the ASME Boiler and Pressure Vessel Code and Section V of ASME B31.1.
2. Structural Aluminum: AWS D1.2/D1.2M.
3. Structural Carbon Steel: AWS D1.1/D1.1M.
4. Structural Stainless Steel: AWS D1.6/D1.6M.
5. Sheetmetal: AWS D9.1/D9.1M.

2.27 PAINTING

A. General:

1. Painted OEM components do not require additional coating other than touchup to damaged areas. Match the touchup coating to surrounding undamaged surfaces.
2. Finish miscellaneous surfaces to match continuous surfaces.
3. Protect mill galvanized surfaces that are exposed to view, such as raw steel cuts and damage by welding, with multiple coats of matching galvanized paint.
4. Protect mill galvanized surfaces that are concealed, such as raw steel cuts and damage by welding, with multiple coats of zinc-rich paint or matching galvanized paint.
5. Touch up or entirely repaint surface finishes, damaged during shipment and installation, to the original condition, using original materials and methods.

B. Preparation:

1. Submit proposed manufacturer's written preparation and application instructions for information.
2. If paint manufacturer's recommended preparation requirements differ from those indicated, use the more stringent requirements.
3. Before applying a primer and a finish coat, remove oil and grease from surfaces to be coated using clean rags soaked in thinner in accordance with SSPC-SP 1.
4. Treat surfaces to be painted to ensure that paint adheres.

C. Primer:

1. Rust-inhibiting type.
2. Use primer that is compatible with substrate and finish coat.

D. Finish Coat:

1. Finish coat painting system shall be polyurethane.
2. Use dry film thickness recommended by paint manufacturer for each coat.
3. Finish coat color shall be gray

E. Application: Paint the following surfaces with primer and finish coat indicated:

1. Unfinished carbon-steel surfaces.
2. Exposed aluminum surfaces of air-handling unit casing exterior.

2.28 CLEANLINESS REQUIREMENTS

A. General:

1. Provide equipment that has been manufactured, shipped, stored, and installed maintaining highest degree of cleanliness possible.

B. During Manufacturing:

1. Clean materials to be free of mill grease, oxidation, dirt, dust, and other impurities before manufacturing and assembly.
2. Protect casing materials from contamination during manufacturing and assembly.
3. Use sealing materials that do not outgas.
4. Provide OEM components and equipment from their respective manufacturers free of grease, oxidation, and dirt. Store OEM components and equipment indoors. Cover and protect OEM components and equipment to maintain cleanliness. Follow OEM instructions for equipment storage.

C. After Manufacturing:

1. Before shipment, after unit is completely assembled, clean unit inside and out.

   a. Vacuum entire inside to remove dirt, dust, and debris using HEPA-filtered vacuum equipment.
   b. Purge hard to reach surfaces with dry, oil-free, compressed or bottled nitrogen.
   c. Wipe down all surfaces, inside and out, with a residue-free cleaning agent.

2. Protect unit to maintain cleanliness.

D. Shipping:

1. Protect interior and exterior of air-handling unit from exposure to weather dirt, dust, and debris during shipment and rigging with 7 mil shrink wrap.

E. On-Site Storage:

1. If air-handling unit is to be stored before installation, Installer shall work closely with air-handling unit manufacturer for air-handling unit manufacturer to provide adequate protection at the factory to ensure that cleanliness for both unit interior and unit exterior is maintained. This protection shall remain in place until unit startup is performed.
2. For extended periods of storage, provide a means to rotate fan and motor assemblies on a periodic basis (as recommended by manufacturer) without compromising unit cleanliness.

2.29 ACCESSORIES

A. Tool Kit:

1. Manufacturer shall assemble a tool kit specially designed for use in servicing air-handling units furnished.
2. Include only special tools required to service air-handling unit components not readily available for purchase by Owner service personnel in performing routine maintenance.
3. Mark case cover with large and permanent text to indicate special purpose of tool kit, such as "Air-Handling Unit Tool Kit." Text size shall be at least 1 inch high.

2.30 SOURCE QUALITY CONTROL

A. AMCA Compliance:

1. AMCA 201: Air-handling unit manufacturer shall evaluate fan's performance within the air-handling unit in accordance with AMCA 201, "Fans and Systems" and account for conditions within the air-handling unit that could be detrimental to fan's performance by adjusting the fan performance indicated on Drawings.
2. AMCA 205 Certification: Air-handling unit fan's fan efficiency grade (FEG) shall be rated in accordance with AMCA 205, "Energy Efficiency Classifications for Fans".
3. AMCA 210 Certification: Air-handling unit fan's air performance shall be rated in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating".
4. AMCA 500-D: Air-handling unit damper's performance shall be rated in accordance with AMCA 500-D, "Laboratory Methods of Testing Dampers for Rating".

B. NFPA Compliance:

1. NFPA 70: Electrical components, devices, and accessories shall be listed and labeled by a qualified testing agency, and marked for intended location and application.
2. NFPA 90A: Design, fabrication, and installation of air-handling units and components shall comply with NFPA 90A.

C. UL Compliance:
1. UL 1995 Certification: Where indicated, air-handling unit components shall be NRTL listed and labeled in accordance with UL 1995, "Standard for Safety Heating and Cooling Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

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 air-handling units before installation. Reject units with physical damage, and air-handling unit components that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for the following before installation of air-handling units:

1. Structural substrate mounting and anchorage to verify actual sizes, types, and locations.
2. Piping systems to verify actual sizes, types, and locations of connections.
3. Ductwork and plenums to verify actual sizes, types, and locations of connections.
4. Electrical services and controls to verify actual sizes, types, and locations of connections.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting: Install air-handling units at locations indicated on Drawings. Install air-handling units on concrete equipment bases.

1. Units Mounted on Concrete Bases:

a. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided.
b. Level air-handling unit bases using aluminum or stainless steel shims compatible with air-handling unit base material.
c. Fill voids between air-handling unit bases and concrete bases using high-strength non-shrink grout.
d. Continuously seal between concrete bases and perimeter of air-handling unit bases with nonhardening sealant.

2. Comply with requirements for seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Equipment Clearances and Access:

1. Arrange installation of air-handling units to provide access space around air-handling units for service and maintenance and for removal and replacement of internal components.
2. Provide clearance and access required by governing codes and NFPA 70.
3. At a minimum, comply with requirements indicated on Drawings and air-handling unit manufacturer's written instructions.

3.3 PROTECTION DURING CONSTRUCTION

A. Exterior Covers: Cover air-handling units during construction with sealed covers to protect air-handling unit casing and externally mounted components from physical damage, dirt, dust and debris, paint splatter, and any other construction materials.

1. Minor physical damage, as determined by Owner, shall be repaired by air-handling unit factory service personnel to factory-finished condition.
2. Replace air-handling units with damage that in any way compromises the performance indicated.

3.4 DUCT CONNECTIONS

A. Connect ducts and plenums to air-handling unit connections. Comply with requirements in Section 233113 "Metal Ducts."

B. Connect ducts and plenums to air-handling unit connections with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

C. Provide duct transitions required to make field connections to air-handling units.

D. Arrange ducts and plenums to provide unobstructed access to inside of air-handling units.

3.5 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, provide unobstructed access to inside of air-handling units for service and maintenance.

C. Drain Pan Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping."

1. Make connections to air-handling unit connections with unions.
2. Extend drain piping from air-handling unit connection to nearest floor drain and arrange piping to maintain clear service aisle paths free of potential tripping hazards. Provide ramps where low-running piping poses a trip hazard. Ramps shall be constructed of Aluminum Diamond Treadplate: ASTM B632/B632M, Alloy 6061 T6; mill finish; minimum (nominal) 0.063 inch thick.
3.
4. Construct traps near air-handling unit connections to seal airflow from escaping within air-handling unit. Locate traps in a serviceable location that is away from access doors.
5. Install threaded cleanouts at changes in direction.
6. Secure drain piping to structure.

D. Chilled- and Hot-Water Coil Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

1. Comply with requirements indicated on Drawings.
2. Make connections to coils with a flange or union.
3. Connect to each coil inlet with shutoff valve, test plug, pressure gauge and thermometer.
4. Connect to each coil outlet with balancing valve, test plug, pressure gauge, thermometer, and shutoff valve.
5. Connect each coil drain connection with a drain valve, which is full size of drain connection.
6. Connect each coil vent connection with manual vent that is full size of vent connection.

3.6 ELECTRICAL CONNECTIONS

A. Install field power to each air-handling unit electrical power connection. Coordinate with air-handling unit manufacturer and installers.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.7 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.8 STARTUP SERVICE

A. Engage an air-handling unit factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with 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, controls, 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.
5. Verify that bearings and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Install new, clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

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.
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.

3.9 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project for this purpose.

D. Seasonal Adjustments: Make seasonal visits during warranty period to inspect and review operation of equipment. Make necessary adjustments for components observed to require adjustments for proper operation. Prepare and submit a report to Owner documenting each visit, observations, and any adjustments made.

3.10 CLEANING

A. Cleaning Schedule: After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems, and after completing startup service, and immediately before Owner use, clean air-handling units to remove foreign material and construction dirt and dust.

B. Unit Interior: Clean air-handling units internally to factory clean condition. Remove foreign material and construction debris, dirt, and dust.

1. Vacuum clean with HEPA-filtered vacuum and then wipe down with cleaning solution.
2. Clean casing floors, roofs, wall surfaces, access doors, and panels.
3. Clean all internal components, such as, coils, dampers, filter frames, fans, and motors.
4. Clean light fixtures and control devices.

C. Unit Exterior: Clean external surfaces of air-handling units to factory clean condition. Remove foreign material and construction debris, dirt, and dust. Vacuum clean with HEPA-filtered vacuum and then wipe down all surfaces with cleaning solution.

D. Cleaning Materials: Use cleaning materials and products recommended in writing by air-handling unit manufacturer.

E. Acceptance: Following unit cleaning, submit a written request for review and Owner acceptance.

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. After field piping connections are complete, test hydronic coils and connections for leaks.
2. Fan 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.

C. Field Casing Leakage Test:
1. Follow procedures complying with ASHRAE 111.
2. Casing Leakage Performance: Not more than 1 percent of the total unit airflow at 8 inches wg.
3. Assembled air-handling units shall satisfy leakage criteria indicated. Modify air-handling units that fail to satisfy criteria and retest.
4. Submit a test report for each test indicating test equipment, procedures, results, date and time, and full name of personnel performing tests and witnesses.
5. Test report shall be in accordance with ASHRAE 111.
6. Witness Testing:

a. Provide written notification at least 10 business days in advance of testing.
b. Testing shall be conducted in presence of testing and balancing agent.
c. Other parties such as Architect, Engineer, and Owner shall be invited to witness testing with attendance being optional.

D. Field Fan Vibration Test:
1. Test after air-handling unit installation is complete.
2. Three vibration readings shall be taken for each bearing in horizontal, vertical, and axial directions. Record each reading including vibration amplitude verses frequency.
3. Modify fans that fail to satisfy performance criteria and retest.
4. Submit a report for each fan tested indicating air-handling unit designation, fan designation, test equipment, procedures, results, date and time, and full name of personnel performing tests and witnesses.
5. Witness Testing:

a. Provide written notification at least 10 business days in advance of testing.
b. Testing shall be conducted in presence of testing and balancing agent.
c. Other parties such as Commissioning Agent, Architect, and Owner shall be invited to witness testing with attendance being optional.

E. Air-handling Acoustical Performance Test:
1. Air-handling unit acoustic performance shall be verified in accordance with AHRI 260.
2. Air-handling unit supply-air discharge, return-air inlet, and casing radiated sound components shall be measured with air-handling unit operating at design conditions.
3. Submit test reports indicating documentation of test equipment used, test procedures, test results, test date and time, and full names of personnel performing tests and witnesses.

F. Unit or components will be considered defective if unit or components do not pass tests and inspections.

G. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage air-handling unit manufacturer or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

B. Training shall include, but not be limited to, procedures and schedules related to performance, safety, startup and shut down, troubleshooting, servicing, preventive maintenance, and how to obtain replacement parts.

1. Access Doors: Adjustment, gasket removal and replacement, handle removal and replacement, and spare parts.
2. Access Panels: Removal and replacement, adjustment, gasket removal and replacement, and spare parts.
3. Coils: Cleaning, combing fins, draining, venting, removal, and replacement.
4. Controls: Calibration, cleaning, operation, service, removal and replacement, and spare parts.
5. Damper Assemblies: Cleaning, operation, service, removal and replacement, and spare parts.
6. Drain Pans: Cleaning, removal, and replacement.
7. Duct Silencers: Cleaning, removal, and replacement.
8. Fan and Motor Assemblies: Cleaning, operation, removal and replacement, service, and spare parts.
9. Filters: Operation, removal and replacement, frame gasket removal and replacement, clip removal and replacement, and spare parts.
10. Lights, Receptacles, and Switches: Cleaning, operation, service, removal and replacement, and spare parts.

C. Instructor:

1. Instructor shall be factory trained and certified by air-handling unit manufacturer with current training on equipment installed.
2. Instructor’s primary job responsibility shall be Owner training.
3. Instructor(s) shall have not less than three years of training experience with air-handling unit manufacturer and past training experience on at least three projects of comparable size and complexity.

D. Schedule and Duration:

1. Schedule training with Owner at least 10 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.
4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for a one-hour lunch period.
5. Perform not less than eight hours of training.

E. Location: Owner to provide a suitable on-site location to host classroom training.

F. Training Attendance Records: For record purposes, document training attendees at start of each new training session. Record date, time, brief description of training covered during the session, attendee's name, signature, phone number, and e-mail address. Submit scanned copy of sign-in sheet to Owner for each training session.

G. Training Format: Individual training modules to include classroom training followed by hands-on field demonstration and training.

H. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.

I. Training Video Recording: Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

J. Written Acceptance: Obtain Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 237313.19

SECTION 238123.13 - COMPUTER-ROOM AIR-CONDITIONERS, CEILING-MOUNTED 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 ceiling-mounted, computer-room air conditioners.

1.3 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

C. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For computer-room air conditioners, 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.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners 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. Fan Belts: One set for each belt-driven unit.
2. Filters: One set of filters for each unit.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Complete CRAC Unit, including Humidifiers and Control Boards: Not less than two years from date of Substantial Completion.
2. Warranty Period for Compressors: Not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Stulz Air Technology Systems, Inc. (Basis of Design)
B. Vertiv (Liebert)
C. ClimateWorx

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Computer-room air-conditioners, ceiling-mounted units 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 when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

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. Code Compliance:
1. The supplied system shall be with the following compliance approvals: CETL US listed to UL 1995 (2011 Ed. 4)CSA C22.2 No. 236 (2011 Ed. 4).

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

E. Quality Assurance: The manufacturer shall maintain a set of international standards of quality management to ensure product quality. Prior to shipment each system shall be subject to a complete operational and functional testing based on predefined procedures. The air conditioner manufacturer shall be ISO 9001:2015 certified.

2.3 MANUFACTURED UNITS

A. Description: Self-contained, factory assembled, prewired, and pre-piped; consisting of cabinet, fan, filters, and controls.
1. Mounting Configuration: Exposed in the space. The system shall be a ceiling mounted supplemental air conditioner. The air conditioner shall be fully accessible in-place through easily removable side access panels.

B. Cabinet: Galvanized steel serviceable from one side, with baked-enamel finish, insulated with 1/2-inch-thick duct liner, and mounting bracket attached to the unit.
1. Unit with supply and return collars for ducting in the field.
2. Unit with a medium efficiency return air filter box to include disposable filter(s). Filter efficiency shall be rated in accordance with ASHRAE 52-76 dust spot test standard. The filter box shall be factory installed.
3. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Supply-Air Fan:
1. Belt driven or direct driven with a double width, double inlet housing and forward curved blades.
2. Bearings: Permanently lubricated ball bearings sized for an average 100,000 hours of service life.
3. Blowers shall be dynamically and statically balanced to minimize vibration and operate in the Class I range. Belt-driven blower shall have an adjustable base for belt tensioning and a locking system to prevent the motors from moving.
4. Drive Sheave: Motor drive sheaves shall have an adjustable pitch to change the speed of the blower.

D. Hydronic Cooling Coil: Seamless drawn copper tubes mechanically bonded to aluminum fins.
1. Cooling Medium: 35% Glycol solution.
2. Fin Design: Tempered aluminum fins with enhanced fin design for maximum heat transfer.

3. Mounted in a stainless-steel condensate drain pan under coil assembly. Drain pan shall be internally sloped toward unit condensate drain connection.
4. Coil designed for maximum of 500 FPM face velocity.
5. Circuits designed to distribute water into entire coil face area.
6. Manual air bleed vents and drain ports shall be factory installed.
7. Chilled Water Control Valve: Chilled water cooling controlled by a modulating (0-10 Vdc) 2-way, 400 psig rated valve.

E. Hot-Water Reheat/Heat: A factory-installed, copper tube, aluminum-fin heat/ reheat coil and 2-way control valve shall be provided to control the flow of hot water for automatic sensible reheating mode during the dehumidification cycle and automatic heating mode as required.

F. Dehumidification Cycle: During dehumidification control mode, the chilled water valve shall open to allow chilled water flow. Moisture is condensed on the cooling coil and discharged through the condensate drain. Hot-water reheat control valve shall modulate to offset sensible cooling.

G. Steam Generating Humidifier: self-contained atmospheric steam generator. The humidifier assembly shall include an integral fill cup, fill and drain valves, disposable steam cylinder and associated piping. The humidifier shall be equipped with an auto-adaptive control system to optimize water conductivity, minimize energy waste, and maximize cylinder life.
1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
2. Control: Modulating output between 20% and 100% of rated capacity.
3. Drain Cycle: Field-adjustable drain duration and drain interval. The unit shall include draw in water tempering to ensure the drain water does not exceed 140°F during operation.

H. Condensate Pump: A heavy-duty, all-metal condensate pump shall be provided for automatic removal of condensate and humidifier flush water. The condensate pump meets most local codes for certification as a "plenum rated" pump. The condensate pump shall be field installed only.
1. Material of Construction: cast aluminum reservoir and impeller; aluminum reservoir cover and impeller chamber cover; stainless steel fasteners and a stainless-steel motor shaft.
2. Temperature Rating: designed to operate with the higher condensate temperatures caused by the flush and drain cycle of the electrode canister humidifiers.
3. Dual Overflow Safety Switches: In addition to the standard condensate pan overflow safety float(s), the condensate pump shall include an internal overflow safety float switch which, when wired to the A/C remote stop/start terminals, shall open the A/C control circuit, thereby shutting the A/C down in the event of a condensate overflow. Upon sensing overflow, the CRAC unit shall shut down the fan and close the chilled water control valve.

I. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to "off" position. The main power service switch shall be the NEMA-12 non-fused type. The disconnect switch shall have a lockable handle. Switch shall be field installed.

J. Electrical System
1. The electrical system shall conform to National Electrical Code requirements. The control circuit shall be 24 volts AC, wire in accordance with NEC Class II requirements. The

control circuit wire shall not be smaller than 18 AWG. All wiring shall be neatly wrapped and routed in bundles. Each wire shall end with a service loop and be securely fastened by an approved method. Each wire in the unit shall be numbered for ease of service tracing.

2. All electrically actuated components shall be easily accessible from the front of the unit without reaching over exposed high voltage components or rotating parts. Each high voltage circuit shall be individually protected by circuit breakers or manual motor starters on all phases. The blower motor shall have thermal and short circuit protection. Line voltage and 24-volt control circuit wiring shall be routed in separate bundles.
3. The electric box shall be positioned for service convenience and shall include all the contactors, starters, fuses, circuit breakers, terminal boards and control transformer required for operation of the unit and shall allow for full service access.

K. Control System:
1. Microprocessor Controller
   a. The advanced microprocessor-based controller shall be equipped with flexible software capable of meeting the specific needs of the application. The setpoints shall be default and their ranges shall be easily viewed and adjusted from the user interface display. The program and operating parameters shall be permanently stored on a non-volatile system in the event of power failure.
   b. The controller shall be designed to manage temperature and relative humidity (RH) levels to a user defined setpoint via control output signals to the system. Control parameters have variable outputs from 0 to 100% of the full rated capacity.
   c. The controller shall receive inputs for measurable control conditions (temperature, relative humidity, and dew point) via return air or room mounted sensors. The internal logic will then determine if the conditions require cooling, humidification or dehumidification. Control setpoints shall be established to maintain design conditions of the installation. The controller will respond accordingly to changes in these conditions and control the output/demand for the appropriate mode of operation until user defined conditions are achieved.

2. Field Configurable: The program for the controller shall be field configurable, so the operator can select control setpoints specific to the application. The operator interface for the controller is provided via a door mounted user interface display panel. The display panel shall be a backlit LCD graphical display and function keys that give complete control and monitoring capability of the precision cooling system. The menu-driven interface shall provide the ability to scroll through and enter various menu screens. Provide 75 feet display cable for remote mounting of display panel.

3. Password Protection: Access to the Info Menu, Alarms Log, and the ability to monitor room conditions shall be allowed without the use of a password. Modifications to the control setpoints shall require the use of a password. The controller shall be programmed to recognize predetermined security levels before allowing access to display screens containing critical variables. Three secured menu levels (Control, Service and Factory) will support unique passwords that must be entered to access the menu screens so only authorized personnel may perform modifications to the settings.

4. Restorable Parameters/Factory Defaults: Upon initial start-up the system shall operate using the setpoints programmed by the factory. The customer may enter new operating parameters in the Control menu and the system will then operate accordingly. The new setpoints may be stored as, "Customer Default Setpoints". The primary setpoints entered

by the factory remain stored in the controller memory as, "Factory Setpoints". The setpoints for the system may be re-adjusted in the Control menu at any time. If it becomes necessary, the customer may restore the setpoints back to the Customer Default setpoint values or to the original Factory (primary) setpoint values.

5. Timer Feature: The timer shall enable a setup of an operating schedule to automatically scale back or shut down the air conditioner during low demand or unoccupied periods. This is an energy saving feature to create an operating schedule tailored to the needs of the building. An evening (night-setback) schedule may also be created to enable the system to operate at night with relaxed temperature/humidity setpoints and offsets.

6. AC Grouping pLAN Operation: Multiple system controllers shall be able to be connected (grouped) to a pLAN local network, allowing the communication of data and information from each controller to a central control terminal or Lead controller. The Lead controller display screens can be used to monitor and adjust group control variables for the individual system controllers. Each controller connected to the pLAN network shall be identified with its own unique address. Multiple systems consisting of up to eight precision air conditioners equipped with like controllers may be controlled and monitored via the controller. With multiple systems each unit can selectively be configured as Active to operate as a primary A/C, Capacity Assist for staged operation, or as Standby to come online for a failed air conditioning unit to ensure continuous availability. The controller may also be configured to rotate units with timed duty cycling to promote equal run-time and assure that each system, within the rotating group, is operationally exercised on a periodic timed basis.

7. Remote BMS Interface: The controller shall incorporate a communication interface port that can be field connected to a Building Management System via Modbus, BACnet MS/TP, SNMP, HTTP, or BACnet over ETHERNET/IP as configured by the factory. A controller interfaced to a network must be configured for BMS communication.

8. Alarms: Alarm conditions shall activate a red LED indicator that backlights the alarm function key. An alarm condition shall also be enunciated by an audible alarm signal. An alarm is acknowledged by pressing the alarm key. This calls up alarm display screens that provide a text message detailing the alarm conditions. After an alarm condition is corrected, the alarm can be cleared by pressing the alarm key.

9. E² Constant Contact: The control package shall include a Constant Contact short-term power supply for the E² Series Controller to allow the controller to manage the power transfer switch from one primary power source to another while maintaining communications with an active monitoring system. The E² Constant Contact shall permit a minimum of one-minute ride through period. E² Series Controller shall be wall mounted.

10. Included in the system electrical control circuit shall be a 2-pin terminal connection for remote start/stop by remote source.

11. Include remote temperature and humidity sensors with 75 feet of remote display cable.

L. Overflow Safety Float Switch
1. A condensate pan water level switch shall be incorporated to shut the system down if a condensate overflow condition is sensed. Upon sensing overflow, the CRAC unit shall shut down the fan and close the chilled water control valve.

M. Smoke Detection
1. A photo-electric smoke detector shall be factory installed and wired in the return air section. The photo-electric detector shall include built-in circuitry that performs a functional test of all detection circuits at least once every 40 seconds without the need for generating smoke. The UL-listed velocity range shall be 0-3000 fpm. The air conditioner will shut down upon sensing smoke in the return air stream.

N. Firestat
1. Unit provided with a factory wired and mounted firestat. The firestat shuts down the air conditioner upon sensing a high return air temperature.

O. Remote Water Detector-Spot Type
1. A remote single point water/leak detector shall be factory supplied and shall ship separately for field installation. Upon sensing a water leak, the normally closed water detector control circuit shall open, thereby shutting down the system. Upon sensing overflow, the CRAC unit shall shut down the fan and close the chilled water control valve.

P. Fan Motors:
1. The motor(s) shall be 1,725 RPM and shall have overload protection and a minimum NEMA service factor of 1.15.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

2.4 CAPACITIES AND CHARACTERISTICS

A. See equipment schedules on Drawings.

B. Electrical Characteristics:
1. Volts: 208.
2. Phase: Three.
3. Hertz: 60.

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 the Work.

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

C. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and spring hangers of size required to support weight of computer-room air conditioner.

1. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Hot-Water Heating Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Provide shutoff valves in inlet and outlet piping to heating coils.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
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.

C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

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 for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

B. Training Requirements, Schedule, and Duration:
   1. Schedule training with Owner at least 10 business days before first training session.
   2. Training shall occur before Owner occupancy.
   3. Training shall be held at mutually agreed date and time during normal business hours.
   4. Perform not less than four hours of training.
   5. Location: Owner to provide a suitable on-site location to host classroom training.
   6. Training Format: Individual training modules to include classroom training followed by hands-on field demonstration and training.
   7. Training Materials: Provide training materials in electronic format to each attendee.
   8. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
   9. Training Video Recording: Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.
   10. Written Acceptance: Obtain Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238123.13

SECTION 23 13 13 - FACILITY UNDERGROUND FUEL STORAGE TANKS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

The Contractor shall procure and furnish all labor, tools, materials, equipment and appurtenances required for installation of the underground storage systems which include double-wall tanks, manways, vents, piping, fittings, and all other appurtenances as indicated on the Contract Drawings, as specified herein, or as required by the Construction Manager.

1.2 RELATED WORK:

SECTION 40 22 00: PETROLEUM PRODUCTS PIPING
SECTION 40 70 00: INSTRUMENTATION FOR PROCESS SYSTEMS

1.3 SUBMITTALS:

Submittals shall include, but not be limited to the following:

A. 90-day advance notification to Nassau County Department of Health (NCDH) prior to installation of tanks as per Nassau County Public Health Ordinance (NCPHO) Section 21.1.1.

B. Manufacturer's descriptive technical literature, manufacturer's warranty and catalog cuts, including installation instructions for:

1. Underground storage tanks. (Mfr's Lit.)
2. Spill containment manholes. (Mfr's Lit.)
3. Containment sumps. (Mfr's Lit.)
4. Manhole Frames and Covers, Vent Caps. (Mfr's Lit.)
5. Overfill prevention valve, check valves, etc. (Mfr's Lit.)
6. The Contractor shall provide a compatibility certification letter from the tank manufacturer and sump manufacturers certifying that the equipment is compatible with alternative fuels. An example letter is included at the end of this section.

C. Working Drawings:

1. Working drawing shall be submitted to the Construction Manager for approval before the work commences. The working drawings shall clearly indicate the locations and relationship of all equipment, piping, supports, and appurtenances at the tanks, and other areas as appropriate. The drawings shall be fully dimensioned so as to determine the suitability of the installation and shall indicate all valve handle orientations and length or swing radii.
2. The working drawings shall be complete and shall include a complete and comprehensive bill of materials keyed to the drawings. The bill of materials shall provide all information to determine compliance with the Contract Drawings and Specifications.
3. The Contractor is responsible for verifying all dimensions in the field and for ensuring that interferences do not exist between the Contractor's work and the surrounding environment.

4. Any deviations from the Contract Drawings because of physical interferences, substitutions, or field verification shall be clearly indicated on the working drawings.

5. The Contractor shall simultaneously submit the following required shop drawings:

   a. Piping layout drawing

   b. Tanks and appurtenances

   c. Catalog cuts, as appropriate

D. Both a 30-year warranty letter and an "Ethanol compatibility statement letter" from the tank manufacturer.

1.4 GENERAL TESTING AND RESPONSIBILITY:

A. Installation of the underground petroleum storage systems shall be performed by the Contractor who is certified by the tank manufacturer as being specifically trained in double-wall fiberglass tank installation, and who has a minimum of five (5) years proven experience in installing fiberglass tanks.

B. The Contractor shall purchase the petroleum storage systems from a manufacturer approved by the Construction Manager and NCDH. The manufacturer shall maintain a service depot within 25 miles of the site with parts and service personnel available for servicing of parts at any time. The manufacturer shall prepare and submit for approval installation drawings covering these particular installations, and shall furnish required supervision for the installation of the systems, and shall further furnish an experienced installation and maintenance worker for the supervision of personnel in the initial operation and maintenance of the systems.

C. The Contractor shall be responsible for the procurement and installation of compatible components, and shall perform all modifications necessary for the proper operation and guarantee of the equipment. The Contractor, if required by the Construction Manager or as otherwise required by the Specifications, shall make such tests during the installation and upon the completion thereof, as may be necessary to demonstrate that the work and equipment, as installed, complies with the Contract Specifications and requirements as provided herein. The Contractor shall provide all labor, instruments, and apparatus required for such tests. If any of the work or equipment fails to meet the Contract requirements or to function properly, the defects shall be rectified at the Contractor's expense by readjusting, or by removing and replacing the faulty work or equipment until, under test, the requirements are met. The NCDPW reserves the right to check the Contractor's instruments or to furnish its own instruments.

D. Whenever, in these Specifications, mention is made of items or details not indicated on the Contract Drawings, or where items or details are indicated on the Contract Drawings and not mentioned in these Specifications, they are deemed to be included in the systems.

1.5 ALTERATIONS TO ACCOMMODATE EQUIPMENT:

The Contract Drawings indicate a typical installation based on a certain make or brand of equipment, and are not to be construed as representing the layout for any other make or brand. Any alterations which are necessary to adequately and satisfactorily accommodate the equipment to be installed under this Contract shall be made by the Contractor at his own expense, in accordance with the Contract Specifications and subject to prior approval by the Construction Manager.

1.6 APPLICABLE STANDARDS:

A. All work performed under this section shall comply with the following rules, regulations,

standards and all other applicable federal, State, and local standards including revisions to the date of the Notice to Proceed.

NYSBC	New York State Building Code
USEPA	United States Environmental Protection Agency
ASME	American Society of Mechanical Engineers
NFPA	National Fire Protection Association
UL	Underwriter's Laboratories
NEC	National Electrical Code
NYSEC	The New York State Electrical Code
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronics Engineers, Board of Standards
API	American Petroleum Institute
NCPHO	Nassau County Public Health Ordinance

B. Prepare and submit to such agencies all plans and specifications required by them, obtain all necessary approvals and permits and deliver to the Construction Manager prior to the start of work.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Only the latest editions of reference standards, codes and specifications in force at the date of bid opening shall be applicable unless otherwise specially noted. These shall be supplemented and superseded by, if in conflict, the NYS Building Code.

B. All electrical materials and equipment shall be UL-listed.

2.2 UNDERGROUND STORAGE TANKS:

A. Tanks shall be as shown on Contract Drawings. Tanks shall be double-wall fiberglass reinforced plastic (FRP) tanks. Tanks shall have a space between the primary and secondary shell walls to allow for the free flow and containment of all leaked product from the primary tank. Space also allows for the insertion of a monitoring device. The tank shall be as manufactured by Containment Solutions of Conroe, Texas, Xerxes Corporation of Minneapolis, Minnesota, or an approved equal.

B. Tanks shall have a primary shell wall capable of withstanding a 15 psi hydrostatic pressure test, and a secondary shell capable of withstanding a 5 psi pressure test. The tank and tank manufacturer shall be approved by the NCDH for underground installation in Nassau County.

C. The tank shall include the following appurtenances, as shown on the Contract Drawings. Appurtenances shall be of the same manufacturer as the tank manufacturer:

1. 22-inch fiberglass manways with 28-inch manway cover.

2. 42-inch fiberglass attached collar riser (ACR) and watertight attached Tank Top Containment Sump (TTCS). TTCS units shall be installed as shown on the Contract Drawings and as recommended by the manufacturer, as required by the Construction Manager.

3. 22-inch fiberglass attached collar riser (ACR) and watertight attached Tank Top Containment Sump (TTCS). TTCS units shall be installed as shown on the Contract

Drawings and as recommended by the manufacturer, as required by the Construction Manager.

4. At least four (4) anchoring straps are required for each installed tank. Straps shall be constructed of fiberglass reinforced plastic. The number of straps shall be as recommended by the manufacturer of the tank being installed.

5. A sufficient number of National Pipe Thread (NPT) fittings shall be supplied in the manways to accommodate all piping and monitoring devices. The location and number of fittings shall be as shown on the Contract Drawings.

D. Surface Loads: The tank shell shall be able to withstand H-20 axle loads when properly installed according to manufacturer's installation instructions.

E. Tanks shall be provided with two (2) permanent lamacoid or stainless steel labels, which shall contain the following information:

1. Certify the tanks conforms to 6 NYCRR Part 613 as well as to the Nassau County Public Health Ordinance, Article XI;

2. Name of the manufacturer and the year of manufacture;

3. Design standard according to which the tank is fabricated;

4. Tank wall thickness;

5. Tank capacity in GALLONS (design capacity and working capacity);

6. Tank dimensions; and

7. Type of petroleum products to be stored.

The first lamacoid or stainless steel label, supplied by the tank manufacturer, showing all the above information as well as the date of installation shall be conspicuously displayed and permanently affixed by the installer to the tank top whereas the second shall be conspicuously displayed and permanently affixed by the installer to the fill box.

F. The Contractor shall provide a steel wear plate minimum 10 gauge thick under each tank opening. Each plate shall be 1 square foot (min.), installed so as to avoid crevice corrosion.

2.3 SPILL CONTAINMENT FILL BOX

A. Fill Spill Containment (FSC) shall be ULC listed, 5-gallon capacity for use with direct or remote fills for below or at grade use.

B. FSC unit shall be double wall (DW) construction with 4" FPT fill port connections, waterproof top locking hatch, internal push drain and interstitial access port.

C. FSC unit shall be designed for manual or electronic hydrostatic monitoring. FSC unit shall include a hydrostatic interstitial cap with integral vent and sensor positioning shelf. The interstitial space shall be filled at installation with factory supplied interstitial fluid (propylene glycol) to allow for electronic monitoring of the primary and secondary containment walls.

D. The FSC shall be fitted with a contractor supplied hydrostatic interstitial leak sensor, fill adaptor and cap.

E. All FSC shall be recessed below an H-20 rated grade level access manhole and cover supplied by contractor.

F. FSC unit shall be Model #EBW 705556211BLK available thru Franklin Fueling Systems or an approved equal.

2.4 EMERGENCY SHUTOFF SWITCH:

Emergency pump shut-off switches shall be installed as shown on the Contract Drawings and as required by the New York State Fire Code. All new emergency pump shut off switches shall have a cover and be pancake-type and shall sound an audible alarm and flash a visual alarm when activated.

2.5 SIGNAGE

The Contractor shall be required to supply and install all signage required by Chapter 23 of the New York State Fire Code – "Fire Code" including:

1. "It is illegal and dangerous to fill unapproved containers with fuel." adjacent to or on each fuel dispensing island;
2. "Smoking is prohibited." adjacent to or on each fuel dispensing island;
3. "The engine shall be shut off during the refueling process." adjacent to or on each fuel dispensing island;
4. "Portable containers shall not be filled while located inside the trunk, passenger compartment, or truck bed of a vehicle." adjacent to or on each fuel dispensing island;
5. "It is unlawful for customers to fill portable containers. See attendant for assistance." adjacent to or on each fuel dispensing island;
6. "Emergency Shut-Off Switch" adjacent to the fuel dispensing shut-off switch; and
7. "Caution: When Alarm Sounds, Tank Filled to Capacity. Do Not Overfill" adjacent to each overfill alarm.

2.6 MANHOLES:

Manholes shall be installed as shown on the Contract Drawings, as required by the Construction Manager, or as specified herein.

A. The cover shall have been tested in its own frame and capable of supporting a minimum load of 40 ton wheel loading.

B. Each cover shall be color coded per API color and symbol code. The surface resistivity of each cover shall prevent the buildup of static charge.

C. Skirts: Shall be made of galvanized steel, unless otherwise specified on the Contract Drawings.

D. Gaskets: Buna-N or an approved equal.

E. Manhole Manufacturer and Model shall be Fibrelite or MwayPro as manufactured by Icon Containment Solutions, and as specified on the Contract Drawings, or an approved equal.

2.7 OVERFILL PROTECTION VALVES:

A. Each gasoline UST shall be equipped with an approved overfill prevention valve that is suitable for use on a gravity fill line. The overfill prevention valve shall be 71SO Series as manufactured by OPW Division, A Dover Company, or an approved equal.

2.8 FUEL OIL SPILL CLEAN-UP KIT

A. Fuel spill clean-up materials shall be provided for each new tank installation near the tank, or related equipment as necessary to control leaks and slipping hazards.

B. The fuel spill clean-up kit shall contain at a minimum:

1. Twenty Five (25) 15 in x 20 in Stat-Mat Absorbent Pads (14 oz volume absorbed per pad)
2. Four (4) Dry Loose Absorbents in Spill Pouches (5 gal volume absorbed per pouch)
3. Four (4) External dia. 3 in x 48 in Static-Dissipative Absorbent Socks (1 gal volume absorbed per sock)
4. One (1) Apron
5. One (1) Economy Goggle
6. One (1) Pair of 13 in L Neoprene Gloves
7. Five (5) 18 in x 30 in Polyethylene Disposal Bags
8. One (1) Roll of Caution Tape
9. One (1) Dustpan / Broom

C. The fuel spill clean-up kit shall be packaged for convenient storage.

D. The fuel spill clean-up kit shall be PIG Spill Kit/Station: 8 gal Volume Absorbed per Kit, Black, or an approved equal.

2.9 EXTRACTABLE CHECK VALVE

A. An approved extractable check valve designed to hold prime in suction systems shall be properly installed in the liquid supply line at the base of each suction dispenser. If supplied suction dispenser comes equipped with primary check valve, a secondary check valve is not required.

B. The valve shall be installed so that the shear groove is flush with or within 0.5 inch of the top of the concrete dispenser island and there is clearance provided for maintenance purposes around the valve body and operating parts.

C. Check valves shall be installed and maintained in accordance with the manufacturer's instructions, tested at the time of initial installation and tested at least yearly thereafter.

D. Check valve shall be 70S Series as manufactured by OPW Division, A Dover Company, or approved equal.

2.10 DISPENSER HOSE

A. Dispenser hoses shall be a minimum of 15 feet in length unless otherwise approved. Dispenser hoses shall be listed and approved. When not in use, hoses shall be reeled, racked or otherwise protected from damage. The length of the dispensing hose shall be such that at least 1-inch clearance between the hose and the ground is maintained when the nozzle is rested on its bracket. Dispenser hose shall be ¾" Futura Hose as manufactured by Goodyear Rubber Products, Inc.

B. Dispenser hoses shall be equipped with a listed emergency breakaway device designed to retain liquid on both sides of a breakaway point. Such devices shall be installed and maintained in accordance with the manufacturer's instructions. Where hoses are attached to hose-retrieving mechanisms, the emergency breakaway device shall be located between the hose nozzle and the point of attachment of the hose-retrieval mechanism to the hose. Breakaway connector shall be CTM-75 Series, Catlow, or approved equal.

2.11 FUEL DELIVERY NOZZLES

A. A listed automatic-closing-type hose nozzle valve with a latch-open device shall be provided for dispensers used for dispensing liquid motor fuel.

B. Special requirements for nozzles:

1. When the flow of product is normally controlled by devices or equipment other than the hose nozzle valve, the hose nozzle valve shall not be capable of being opened unless the delivery hose is pressurized. If pressure to the hose is lost, the nozzle shall close automatically.

   Exception: Vapor recovery nozzles incorporating insertion interlock devices designed to achieve shutoff on disconnect from the vehicle fill pipe.

2. The hose nozzle shall be designed such that the nozzle is retained in the fill pipe during the filling operation.

3. The system shall include listed equipment with a feature that causes or requires the closing of the hose nozzle valve before the product flow can be resumed or before the hose nozzle valve can be replaced in its normal position in the dispenser.

C. Control device. A control device shall be provided that will allow a liquid motor fuel pump to operate only when the dispensing nozzle is removed from its bracket on the dispenser and the switch on the dispenser is manually activated. The flow of liquid motor fuel shall automatically stop when the switch is deactivated or the nozzle returned to its bracket.

D. Nozzle shall be Model 11BP as manufactured by the OPW Division, A Dover Company, or approved equal.

E. The nozzle shall be equipped with a ¾" hose swivel model 241TPS-0241 as manufactured by OPW, or an approved equal.

2.12 UNDER DISPENSER CONTAINMENT SUMP

A. Under Dispenser Containment Sump (UDCS) shall be single wall (SW) FRP.

B. UDCS shall include offset electric conduit frame. Top frame shall be stainless steel.

C. UDCS shall be a Model DS-1928 as manufactured by OPW, or an approved equal.

D. UDCS shall have a low point sump leak sensor.

PART 3 - EXECUTION

3.1 GENERAL:

A. Maintain the site in a neat and workmanlike manner. Remove debris, dirt, rubbish, etc. from the site at the end of each day.

B. Initiate a safety program to prevent injury to residents, employees and visitors. Do not block streets or exits. Provide maintenance and protection of traffic including pedestrians.

C. Provide and maintain any structures or lighting, and take all measures required by law for protection of the public.

D. Contract work shall be completed in a professional manner so that no damage or injury will occur to the environment, public, to all properties and structures including streets, paving,

monitoring wells, recovery wells, sewers, water, electric or any other pipes, mains, conduits and utilities. Should any damage or injury be caused by the Contractor or any one in his employ, or by improper or defective work under this Contract, repair such damage and assume all responsibility for such injury without cost to the County or the Construction Manager. The work area shall be kept lighted at night by lantern or other approved lighting device.

E. At excavations, provide barriers on the same day that the excavation is made and check barrier integrity daily so that the public is protected at all times.

3.2 INSTALLATION:

A. The equipment installed by the Contractor shall be installed in accordance with the Manufacturer's instructions.

3.3 UNDERGROUND STORAGE TANK TESTING REQUIREMENTS:

A. Primary tank shall be hydrostatically tested at 15 psi, or one and one-half times the maximum anticipated static head pressure, whichever is greater, at the factory in accordance with NCDH requirements. The test shall be conducted for not less than 60 minutes.

B. The secondary tank shall be air pressure tested at not less than 5 psi for a period of not less than 60 minutes.

C. Testing of the tanks and equipment shall conform to the testing methods and procedures established in the referenced standards. Where leaks are detected, the tanks and equipment must be repaired as recommended by standards.

3.4 UNDERGROUND STORAGE TANK CONTAINMENT SUMP TESTING REQUIREMENTS:

Each tank containment sump assembly shall be tested in accordance with the manufacturer's testing equipment and methods to verify the integrity of the sump assembly. This test shall demonstrate that the sump assembly, including all piping and conduit entry boots, the tank manway, and the manhole cover and frame assembly, is watertight. Each containment sump assembly shall be tested in the presence of the Construction Manager at different stages of installation to verify the integrity of the sump assembly. This test shall be performed on each sump assembly after installation of piping and conduit, after placement of backfill, and when tank top slab is installed and installation is complete. If a sump assembly fails this test, the Contractor shall take appropriate steps, at his own expense, to correct the installation until he can demonstrate that the sump is watertight.

3.5 UNDER DISPENSER CONTAINMENT SUMP TESTING REQUIREMENTS:

Each UDCS assembly shall be tested in accordance with the manufacturer's testing equipment and methods to verify the integrity of the sump assembly. This test shall demonstrate that the sump assembly, including all piping and conduit entry boots, is watertight. Each containment sump assembly shall be tested in the presence of the Construction Manager at different stages of installation to verify the integrity of the sump assembly. This test shall be performed on each sump assembly after installation of piping and conduit, after placement of backfill, and when installation is complete. If a sump assembly fails this test, the Contractor shall take appropriate steps, at his own expense, to correct the installation until he can demonstrate that the sump is watertight.

3.6 OPERATIONS AND MAINTENANCE (O&M) MANUALS:

The Contractor shall provide five (5) O&M manuals in 3-ring loose-leaf vinyl binders incorporating all manufacturers' information describing operations and maintenance schedules for the system installed.

The O&M manuals shall include wiring diagrams and detailed equipment list and spare parts required at standard service intervals and contact information for a manufacturer service representative.

END OF SECTION 231323

SAMPLE LETTER OF COMPATIBILITY PRODUCTS WITH ALTERNATIVE FUELS SUCH AS BIODIESEL AND ETHANOL BLENDED FUELS

This also addresses compatibility with DEF Diesel Exhaust Fluid.

This letter is to certify the compatibility of (Company name) Single and Double Wall Fiberglass Containment Sumps with Alternative Fuels such as Biodiesel and Ethanol blended fuels. It also addresses compatibility with DEF Diesel Exhaust Fluid.

(Company name) Fiberglass products are engineered with the same UL Listed materials used in the manufacture and certification of Fiberglass Tanks, matching the UL Standard 1316. Since our Fiberglass containment sumps are Built like a Tank, they can withstand continuous fuel exposure to Biodiesel, Ethanol and Alcohol blends without failure.

All Double Wall Containment Sumps are engineered to be fully compliant with the California State Water Resource Control Board Assembly Bill AB-2481 for Double Wall Sumps and Continuous Monitoring Systems.

The following Single and Double Wall Containment Sumps manufactured by (Company name), are compatible with Biodiesel and Ethanol fuel blends up to B100 and E100, respectively.

Series Spill Buckets Series UDC Sumps

Series Tank Sumps & Covers Series UDC Sumps

Series Planter Transition Sumps Series UDC Sumps

Series Walkover Transition Sumps Series UDC Sumps

Series H-20 Rated Transition Sumps

Series Transition Sumps

(Company name) also certifies that these products are compatible with and approved for use in secondarily containing DEF Diesel Exhaust Fluid. Each respective Series may be UL Listed in addition to being manufactured of UL recognized materials approved for use in the manufacture of Fiberglass UST tanks. Any other relevant documentation will be located in the documents area of each product's respective webpage.

Please feel free to contact us with any questions you may have at (Company name and Telephone Number).

Additionally, you may find further information at www. (Company name).com

NO TEXT ON THIS PAGE

SECTION 260010 – SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. A: Ampere, unit of electrical current.
2. AC or ac: Alternating current.
3. AFCI: Arc-fault circuit interrupter.
4. AIC: Ampere interrupting capacity.
5. AL, Al, or ALUM: Aluminum.
6. ASD: Adjustable-speed drive.
7. ATS: Automatic transfer switch.
8. AWG: American wire gauge; see ASTM B258.
9. BAS: Building automation system.
10. BIL: Basic impulse insulation level.
11. BIM: Building information modeling.
12. CAD: Computer-aided design or drafting.
13. CATV: Community antenna television.
14. CB: Circuit breaker.
15. cd: Candela, the SI fundamental unit of luminous intensity.
16. CO/ALR: Copper-aluminum, revised.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.
24. DC or dc: Direct current.
25. DCOA: Designated critical operations area.
26. DDC: Direct digital control (HVAC).
27. EGC: Equipment grounding conductor.
28. ELV: Extra-low voltage.
29. EMF: Electromotive force.
30. EMI: Electromagnetic interference.
31. EPM: Electrical preventive maintenance.

32. EPS: Emergency power supply.
33. EPSS: Emergency power supply system.
34. ESS: Energy storage system.
35. EV: Electric vehicle.
36. EVPE: Electric vehicle power export equipment.
37. EVSE: Electric vehicle supply equipment.
38. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
39. FLC: Full-load current.
40. ft: Foot.
41. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
42. GEC: Grounding electrode conductor.
43. GFCI: Ground-fault circuit interrupter.
44. GFPE: Ground-fault protection of equipment.
45. GND: Ground.
46. HACR: Heating, air conditioning, and refrigeration.
47. HDPE: High-density polyethylene.
48. HID: High-intensity discharge.
49. HP or hp: Horsepower.
50. HVAC: Heating, ventilating, and air conditioning.
51. Hz: Hertz.
52. IBT: Intersystem bonding termination.
53. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
54. IP: Ingress protection rating (enclosures); Internet protocol (communications).
55. IR: Infrared.
56. IS: Intrinsically safe.
57. IT&R: Inspecting, testing, and repair.
58. ITE: Information technology equipment.
59. kAIC: Kiloampere interrupting capacity.
60. kcmil or MCM: One thousand circular mils.
61. kV: Kilovolt.
62. kVA: Kilovolt-ampere.
63. kVAr or kVAR: Kilovolt-ampere reactive.
64. kW: Kilowatt.
65. kWh: Kilowatt-hour.
66. LAN: Local area network.
67. lb: Pound (weight).
68. lbf: Pound (force).
69. LCD: Liquid-crystal display.
70. LCDI: Leakage-current detector-interrupter.
71. LED: Light-emitting diode.
72. Li-ion: Lithium-ion.
73. lm: Lumen, the SI derived unit of luminous flux.
74. LNG: Liquefied natural gas.
75. LP-Gas: Liquefied petroleum gas.
76. LRC: Locked-rotor current.

77. LV: Low voltage.
78. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
79. m: Meter.
80. MCC: Motor-control center.
81. MDC: Modular data center.
82. MG set: Motor-generator set.
83. MIDI: Musical instrument digital interface.
84. MLO: Main lugs only.
85. MV: Medium voltage.
86. MVA: Megavolt-ampere.
87. mW: Milliwatt.
88. MW: Megawatt.
89. MWh: Megawatt-hour.
90. NC: Normally closed.
91. Ni-Cd: Nickel-cadmium.
92. Ni-MH: Nickel-metal hydride.
93. NIU: Network interface unit.
94. NO: Normally open.
95. NPT: National (American) standard pipe taper.
96. OCPD: Overcurrent protective device.
97. ONT: Optical network terminal.
98. PC: Personal computer.
99. PCS: Power conversion system.
100. PCU: Power-conditioning unit.
101. PF or pf: Power factor.
102. PHEV: Plug-in hybrid electric vehicle.
103. PLC: Programmable logic controller.
104. PLFA: Power-limited fire alarm.
105. PoE: Power over Ethernet.
106. PV: Photovoltaic.
107. PVC: Polyvinyl chloride.
108. pW: Picowatt.
109. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
110. RMS or rms: Root-mean-square.
111. RPM or rpm: Revolutions per minute.
112. SCADA: Supervisory control and data acquisition.
113. SCR: Silicon-controlled rectifier.
114. SPD: Surge protective device.
115. sq.: Square.
116. SWD: Switching duty.
117. TCP/IP: Transmission control protocol/Internet protocol.
118. TEFC: Totally enclosed fan-cooled.
119. TR: Tamper resistant.
120. TVSS: Transient voltage surge suppressor.
121. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
122. UL CCN: UL Category Control Number.
123. UPS: Uninterruptible power supply.
124. USB: Universal serial bus.
125. UV: Ultraviolet.
126. V: Volt, unit of electromotive force.
127. V(ac): Volt, alternating current.

128. V(dc): Volt, direct current.
129. VA: Volt-ampere, unit of complex electrical power.
130. VAR: Volt-ampere reactive, unit of reactive electrical power.
131. VFC: Variable-frequency controller.
132. VOM: Volt-ohm-multimeter.
133. VPN: Virtual private network.
134. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
135. W: Watt, unit of real electrical power.
136. Wh: Watt-hour, unit of electrical energy usage.
137. WPT: Wireless power transfer.
138. WPTE: Wireless power transfer equipment.
139. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See "LFNC."
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.

36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.

36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
2. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
3. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.

4. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
5. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
6. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
7. Direct Buried: Installed underground without encasement in concrete or other protective material.
8. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Concrete Box: A box intended for use in poured concrete.
    c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
    d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
    e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
    f. Device Box: A box with provisions for mounting a wiring device directly to the box.
    g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
    h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
    i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
    j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
    k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
    l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.

m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

9. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
10. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
12. Jacket: A continuous nonmetallic outer covering for conductors or cables.
13. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
18. Sheath: A continuous metallic covering for conductors or cables.

19. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
    f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

21. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Tenant no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Tenant's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:

    a. Exercising generators.
    b. Emergency lighting.
    c. Elevators.
    d. Fire-alarm systems.

B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.4 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 ACTION SUBMITTALS

A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.

B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections 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. Suspended ceiling components.
2. Structural members to which equipment and suspension systems will be attached.
3. Size and location of access panels on ceilings.
4. Elevation, size, and route of sprinkler piping.
5. Elevation, size, and route of plumbing piping.
6. Elevation, size, and route of ductwork.
7. Elevation, size, and route of cable tray.
8. Elevation, size, and route of conduit.
9. Elevation and size of wall-mounted and ceiling-mounted equipment.
10. Access panels.
11. Sprinklers.
12. Air inlets and outlets.
13. Control modules.
14. Luminaires.
15. Communications devices.
16. Speakers.
17. Security devices.
18. Fire-alarm devices.
19. Indicate clear dimensions for maintenance access in front of equipment.
20. Indicate dimensions of fully-open access doors.

C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections 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. Elevation, size, and route of cable trays.
2. Relationships between components and adjacent structural, electrical, and mechanical elements.
3. Vertical and horizontal offsets and transitions.
4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
5. Elevation of ceilings and size of ceiling tiles.
6. Locations of access panels on ceilings.
7. Locations where cable tray crosses or parallels sprinkler piping.
8. Locations where cable tray crosses plumbing piping.

9. Locations where cable tray crosses or parallels ductwork.
10. Locations of access panels on ductwork.
11. Locations where cable tray crosses conduit.
12. Items blocking access around cable trays, including the following:

    a. Light fixtures.
    b. Speakers.
    c. Fire-alarm devices.
    d. Power outlets.
    e. Wall-mounted equipment.
    f. Equipment racks.
    g. Furniture.
    h. Door swings.
    i. Building features.

13. Indicate clear dimension between cable tray and walls or obstructions that are closer than 10 ft (3 m).
14. Highlight locations where cable tray is greater than 3 ft (1 m) above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.

D. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

E. Coordination Drawings for Large Equipment Indoor Installations:

1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

    a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
    b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
    c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.

3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:

    a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.

b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

F. Coordination Drawings for Large Equipment Outdoor Installations:

1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
b. Indicate clear dimensions for fence gates and wall openings.
c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
f. Dimensioned working clearances and dedicated areas around electrical equipment.

G. Coordination Drawings for Duct Banks:

1. Show duct profiles and coordination with other utilities and underground structures.
2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.6 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.
2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.
6. Utility service inspection and activation.
7. Closing of walls and ceilings containing electrical Work.
8. System startup, testing, and commissioning activities for major electrical equipment.
9. System startup, testing, and commissioning activities for emergency lighting.
10. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
11. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
12. Requests for special inspections.
13. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Location and dimensions of structural members supporting wall.
2. Location and dimensions of columns near penetrations.
3. Location and dimension of headers and lintels.
4. Doors and windows near penetrations.
5. Location and dimensions of penetrating cuts.
6. Sprinkler piping and sleeves.
7. Plumbing piping and sleeves.
8. Ductwork and sleeves.
9. Cable tray and sleeves.
10. Conduit and sleeves.
11. Firestopping assemblies for rated penetrations.
12. Structural supports for piping, ductwork, and conduit on both sides of wall.

C. Certificates:

Retain "Welding certificates" Subparagraph below if retaining "Welder" Paragraph in "Qualifications" Article.

1. Welding certificates.
2. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16] for all designated seismic-load systems identified on Drawings or in the Specifications.

    a. Include the following information:

        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.
        4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
        5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction[, or experience data as permitted by][ASCE/SEI 7-05][ASCE/SEI 7-10][ASCE/SEI 7-16].
        6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16].

7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.

Retain first subparagraph only if Designated Seismic Systems are not scheduled on Drawings.

b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:

1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
2) Raceways, enclosures, cabinets, boxes, and their mounting provisions specified in Section 260533 "Raceway and Boxes for Electrical Systems."
3) Seismic restraints specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
4) Cable trays, accessories, and components specified in Section 260536 "Cable Trays for Electrical Systems."
5) Equipment, accessories, and components specified in Section 262413 "Switchboards."
6) Equipment, accessories, and components specified in Section 262416 "Panelboards."
7) Equipment, accessories, and components specified in Section 262419 "Motor-Control Centers."
8) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
9) Equipment, accessories, and components specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
10) Equipment, accessories, and components specified in Section 263353 "Static Uninterruptible Power Supply."
11) Equipment, accessories, and components specified in Section 263600 "Transfer Switches."
12) Luminaires, accessories, and components specified in Section 265119 "LED Interior Lighting."
13) Luminaires, accessories, and components specified in Section 265213 "Emergency and Exit Lighting."
14) Poles and support components specified in Section 265613 "Lighting Poles and Standards."
15) Luminaires, accessories, and components specified in Section 265619 "LED Exterior Lighting."

3. Wind-Load Performance Certificates: Provide special certification for systems and components designated on Drawings or in the Specifications to be subject to high wind exposure and impact damage.

a. Include the following information:

1) Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.

2) Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

D. Qualification Statements:

1. For qualified regional manufacturer.
2. For structural professional engineer.
3. For electrical professional engineer.
4. For lighting professional engineer.
5. For EPM specialist.
6. For welder.
7. For switchboard Installer.
8. For generator set Installer.
9. For lightning protection system Installer.
10. For low-voltage electrical testing agency and on-site electrical testing supervisor.
11. For structural testing and inspecting agency.
12. For outdoor pole testing and inspecting agency.
13. For luminaire photometric testing laboratory.
14. For lighting testing and inspecting agency.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:

a. ATS.

b. Switchboards.

c. Electrical Generator.

2. Include the following information:

a. Manufacturer's operating specifications.
b. User's guides for software and hardware.
c. Schedule of maintenance material items recommended to be stored at Project site.
d. Detailed instructions covering operation under both normal and abnormal conditions.
e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
f. List of load-current and overload-relay heaters with related motor nameplate data.
g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
h. Manufacturer's instructions for setting field-adjustable components.
i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.

k. Exterior pole inspection and repair procedures.

1.8 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including seismic- and wind-load modeling and analysis.

C. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.

D. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:

1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).

E. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable in accordance with electrical utility service provider's requirements.

1. Medium-voltage cable Installer must be approved by electrical utility service provider.

F. Medium-Voltage Duct Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with installation of medium-voltage duct banks in accordance with electrical utility service provider's requirements.

1. Medium-voltage duct Installer must be approved by electrical utility service provider.

G. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.

H. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials or unexpired LPI Master Installer credentials prior to starting installation.

I. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

J. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

K. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.

L. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.

M. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.2 SYSTEM STARTUP

A. Commissioning Activities:

1. See Section 260800 "Commissioning of Electrical Systems".

3.3 FIELD QUALITY CONTROL

A. Administrant for Low-Voltage Electrical Tests and Inspections:

1. Tenant will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

B. Administrant for Power-Limited Electrical Tests and Inspections:

1. Tenant will engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.

C. Administrant for Field Tests and Inspections of Lighting Installations:

1. Tenant will engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.

END OF SECTION 260010

SECTION 260513 – MEDIUM VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cables.
2. Connectors.
3. Medium-voltage tapes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate location of each cable, splice, and termination.

B. Material Certificates: For each type of cable and accessory.

C. Design Data: Cable pulling calculations, including conduit size and fill percentage, pulling tensions, cable sidewall pressure, jam probability, voltage drop, and ground wire sizing for each cable.

D. Source quality-control reports.

E. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Manufacturers

a. American Insulated Wire Corp.; a Leviton Company.
b. General Cable Technologies Corporation.
c. Kerite Co. (The); Hubbell Incorporated.
d. Okonite Company (The).
e. Pirelli Cables & Systems NA.
f. Rome Cable Corporation.
g. Southwire Company.

B. Cable Type: Type MV 105.

C. Conductor Insulation: Crosslinked polyethylene.

1. Voltage Rating: 15 kV.
2. Insulation Thickness: 133 percent insulation level.

D. Conductor: Copper.

E. Conductor Stranding: Compact round, concentric lay, Class B.

F. Strand Filling: Conductor interstices are filled with impermeable compound.

G. Shielding: Solid copper wires, helically applied over semiconducting insulation shield.

H. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.

I. Three-Conductor Cable Assembly: Three insulated, shielded conductors cabled together with ground conductors.

1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.

J. Cable Jacket: Sunlight-resistant PVC.

2.3 CONNECTORS

A. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

B. Copper-Conductor Connectors: Copper barrel crimped connectors.

2.4 MEDIUM-VOLTAGE TAPES

A. Description: Electrical grade, insulating tape rated for medium voltage application.

B. Ethylene/propylene rubber-based, 30 mil (0.76 mm) splicing tape, rated for 130 deg C operation. Minimum 3/4 inch (20 mm) wide.

C. Silicone rubber-based, 12 mil (0.30 mm) self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inch (38 mm) wide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inch (1200 to 1800 mm) on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Install "buried-cable" warning tape 12 inch (305 mm) above cables.

F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

G. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

H. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
3. Standoff Insulator: At each terminal junction, with one on each terminal.

I. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."

J. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.

K. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

B. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Nonmetallic underground conduit with conductors, Type NUCC.
3. Metal-clad cable, Type MC.
4. Armored cable, Type AC.
5. Mineral-insulated cable, Type MI.
6. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers

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.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 NONMETALLIC UNDERGROUND CONDUIT WITH CONDUCTORS, TYPE NUCC

A. Description: A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.

B. Applicable Standards:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards: UL 1990.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.

C. Circuits:

Retain first option in first subparagraph below for single-circuit Type MC cable. Retain second option to allow multiple circuits per cable. If retaining both options, indicate where used on Drawings.

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

2. Type XHHW-2: Comply with UL 44.

G. Armor:Steel, interlocked.

H. Jacket: PVC applied over armor.

2.4 ARMORED CABLE, TYPE AC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 4.

C. Circuits:

Retain first option in first subparagraph below for single-circuit Type AC cable. Retain second option to allow multiple circuits per cable. If retaining both options, indicate where used on Drawings.

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.

G. Armor: Steel, interlocked.

2.5 MINERAL-INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper.

D. Insulation: Compressed magnesium oxide.

E. Sheath: Copper.

F.

2.6 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers:

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. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. 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 THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

Coordinate "Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground" Paragraph below with Section 260543 "Underground Ducts and Raceways for Electrical Systems."

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2 or single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch (300 mm)] of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

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 Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:

    a. Electrical generator

    b. ATS.

    c. Switchboards.

3. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. 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.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:

1. Test wells.
2. Rod electrodes.
3. Ring electrodes.
4. Busbar.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:

1) Test wells.

2) Rod electrodes.
3) Ring electrodes.
4) Grounding arrangements.
5) Ground bars.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:
1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

C. UL KDER - Armored Grounding Wire:

1. Description: Single corrosion-resistant copper, aluminum, or copper-clad aluminum conductor within helically formed steel armor.
2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDSH - Protector Grounding Conductor:

1. Description: Conductors intended to be used for grounding primary protector or metallic members of cable sheath in accordance with Chapters 7 and 8 of NFPA 70.
2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. Listing Criteria:

a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

4. Options:

a. Color: green.

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
1. General Characteristics:

a. Two pieces with zinc-plated bolts.
b. Clamp Material: Die-cast zinc alloy, Brass, Tinned brass.
c. Listed for outdoor use.

E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
1. General Characteristics:

a. Clamp Material: Brass, Tinned brass.
b. Listed for outdoor use.

F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:
1. General Characteristics:

a. Clamp Material: Copper, Tinned copper, galvanized steel.
b. Listed for outdoor use.

G. UL KDER - Beam Grounding and Bonding Clamp:

1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

H. UL KDER - Exothermically Welded Connection:
1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing:
1. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:
1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub:
1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

a. Copper, Copper alloy, Tinned copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:

1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.

    a. Copper, Copper alloy, Tinned copper.

I. UL KDER - Signal Reference Grid Grounding and Bonding Connector:
1. General Characteristics: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

2.6 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.

B. Performance Criteria:

1. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

    a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDSH - One-Piece Intersystem Bonding Bridge Grounding Connector:
1. General Characteristics: Zinc-alloy one-piece construction; six terminating points; gangable.

D. UL KDSH - Two-Piece Intersystem Bonding Bridge Grounding Connector:
1. General Characteristics: Copper body and polycarbonate cover; four terminating points.

2.7 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Equipment Room Grounding and Bonding Busbar:
1. General Characteristics:

a. Bus: Rectangular bar of annealed copper.
b. Mounting Stand-Off Insulators: Lexan or PVC.

1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.

2. Options:

a. Dimensions: 1/4 by 4 inch (6.3 by 100 mm) in cross section; length as indicated on Drawings.
b. Predrilled Hole Pattern: 9/32 inch (7.14 mm) holes spaced 1-1/8 inch (28 mm) apart. Suitable for installing specified grounding and bonding connectors.
c. Mounting Hardware: Stand-off brackets that provide 4 inch (100 mm) clearance to access rear of bus. Brackets and bolts must be stainless steel.

E. UL KDER - Rack and Cabinet Bonding Busbar:
1. General Characteristics:

a. Bus: Rectangular bar of hard-drawn solid copper.
b. Horizontal Mounting Dimensions: Designed for mounting in 23 inch (584 mm) wide equipment racks or cabinets.
c. Vertical Mounting Dimensions: Designed for mounting in 72 inch (1827 mm) high equipment racks or cabinets.
d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.8 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode:
1. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft (19 mm by 3 m).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 4 inch (50 mm) minimum from wall, 6 inch (150 mm) 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; connect to horizontal bus.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

G. Underground Grounding Conductors: Install bare copper conductor, 3/0 AWG minimum.

1. Bury at least 30 inch (750 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.

3.4 SELECTION OF CONNECTORS

A. 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.

3.5 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. 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.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Conductors:

a. 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.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.

d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. 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 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 disconnect-type connection is required, use bolted clamp.

g. 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 bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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 bolted connector.
    3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft (18 m) apart.

3. Electrodes:

    a. Ground Rods: Drive rods until tops are 2 inch (50 mm) below 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) Use exothermic welds for below-grade connections.

    b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch (300 mm) deep, with cover.

1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around perimeter of building.

1) Install tinned-copper conductor not less than 3/0 AWG for ring electrode and for taps to building steel.
2) Bury ring electrode not less than 24 inch (600 mm) from building's foundation.

e. Concrete-Encased Electrode (Ufer Ground):

1) Fabricate in accordance with NFPA 70; use minimum of 20 ft (6 m) of bare copper conductor not smaller than 4 AWG.
a) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft (6.0 m) long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Grounding Underground Distribution System Components:

a. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
b. Comply with IEEE C2 grounding requirements.
c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch (50 mm) above to 6 inch (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

d. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch (150 mm) from foundation.

6. Equipment Grounding:

a. Install insulated equipment grounding conductors with 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) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
e. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
f. Metallic Fences: Comply with requirements of IEEE C2.

1) Grounding Conductor: Bare, tinned copper, not less than 8 AWG wire size.
2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
3) Barbed Wire: Strands must be bonded to grounding conductor.

3.6 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

    a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω.
    b. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 Ω.
    c. Pad-Mounted Equipment: 5 Ω.

3.7 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

1.2 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 the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Delegated Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. 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.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
6. Toggle Bolts: All steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. 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 must be weight of supported components plus 200 lb (90 kg).

C. 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 inch (100 mm)

thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.

6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
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 comply with seismic-restraint strength and anchorage requirements.
9. .

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inch (100 mm) 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 (20.7 MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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.

3.4 PAINTING

A. Touchup:

1. 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.

    a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 – CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S duct raceways and elbows.
2. Type ENT duct raceways and fittings.
3. Type HDPE and Type EPEC duct raceways and fittings.
4. Type ERMC-S duct raceways, elbows, couplings, and nipples.
5. Type FMC-S duct raceways.
6. Type FMT duct raceways.
7. Type IMC duct raceways.
8. Type LFMC duct raceways.
9. Type LFNC duct raceways.
10. Type PVC duct raceways and fittings.
11. Fittings for conduit, tubing, and cable.
12. Electrically conductive corrosion-resistant compounds for threaded conduit.
13. Solvent cements.

1.2 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

A. Product Data:

Retain one or more of 17 subparagraphs below as needed to verify compliance of Work with Project requirements.
1. Type EMT-S duct raceways and elbows.
2. Type ENT duct raceways and fittings.
3. Type HDPE duct raceways and fittings.
4. Type FMC-S duct raceways.
5. Type FMT duct raceways.
6. Type IMC duct raceways.
7. Type LFMC duct raceways.

8. Type LFNC duct raceways.
9. Type PVC duct raceways and fittings.
10. Fittings for conduit, tubing, and cable.
11. Electrically conductive corrosion-resistant compounds for threaded conduit.
12. Solvent cements.

B. Sustainable design submittals.

1. Solvent cements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:
1. Type EMT-S duct raceways and elbows.
2. Type ENT duct raceways and fittings.
3. Type HDPE duct raceways and fittings.
4. Type ERMC-S duct raceways, elbows, couplings, and nipples.
5. Type FMC-S duct raceways.
6. Type FMT duct raceways.
7. Type IMC duct raceways.
8. Type LFMC duct raceways.
9. Type LFNC duct raceways.
10. Type PVC duct raceways and fittings.
11. Fittings for conduit, tubing, and cable.
12. Electrically conductive corrosion-resistant compounds for threaded conduit.
13. Solvent cements.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers:

AFC Cable Systems, Inc.
Allied Tube & Conduit; a Tyco International Ltd. Co.
Anamet Electrical, Inc.
Electri-Flex Company.
O-Z/Gedney; a brand of EGS Electrical Group.
Picoma Industries, a subsidiary of Mueller Water Products, Inc.
Republic Conduit.
Robroy Industries.
Southwire Company.
Thomas & Betts Corporation.
Western Tube and Conduit Corporation.
Wheatland Tube Company; a division of John Maneely Company.

2. Material: Steel.
3. Options:

   a. Exterior Coating: Zinc.
   b. Interior Coating: Zinc.
   c. Minimum Trade Size: trade size 3/4.
   d. Colors: As indicated on Drawings.

2.2 TYPE ENT DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FKHU; including UL 1653.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FKHU - Electrical Nonmetallic Tubing (ENT) and Fittings:

1. Manufacturers:

   AFC Cable Systems, Inc.
   Anamet Electrical, Inc.
   Arnco Corporation.
   CANTEX Inc.
   CertainTeed Corp.
   Condux International, Inc.
   Electri-Flex Company.
   Kraloy.

Lamson & Sessions; Carlon Electrical Products.
Niedax-Kleinhuis USA, Inc.
RACO; a Hubbell company.
Thomas & Betts Corporation.

2. Options:

a. Minimum Trade Size: trade size 3/4.
b. Fittings:

1) Mechanically Attached Fittings: UL 1653.
2) Solvent-Attached Fittings: UL 651.

2.3 TYPE HDPE DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN EAZX; including UL 651A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL EAZX - Schedule 40 Electrical HDPE Underground Conduit (HDPE-40):
1. Dimensional Specifications: Schedule 40.
2. Options:

a. Minimum Trade Size: trade size 3/4.

D. UL EAZX - Schedule 80 Electrical HDPE Underground Conduit (HDPE-80):
1. Dimensional Specifications: Schedule 80.
2. Options:

a. Minimum Trade Size: trade size 3/4.

2.4 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria: UL CCN DYIX; including UL 6.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
1. Exterior Coating: Zinc.
2. Options:

a. Interior Coating: Zinc.
b. Minimum Trade Size: trade size 3/4.
c. Colors: As indicated on Drawings.

D. UL DYIX - PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
1. Options:

a. Exterior Coating: PVC complying with NEMA RN 1.
b. Interior Coating: Zinc.
c. Minimum Trade Size: trade size 3/4.
d. Colors: As indicated on Drawings.
e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
f. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

2.5 TYPE FMC-S DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):
1. Material: Steel.
2. Options:

a. Minimum Trade Size: trade size 3/4.

b. Colors: As indicated on Drawings.

2.6 TYPE FMT DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ILJW; including UL Subject 1652.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL ILJW - Steel Flexible Metallic Tubing (FMT):
1. Options:

a. Minimum Trade Size: trade size 3/4.
b. Colors: As indicated on Drawings.

2.7 TYPE IMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYBY; including UL 1242.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYBY - Steel Intermediate Metal Conduit (IMC):
1. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc.
c. Minimum Trade Size: trade size 3/4.
d. Colors: As indicated on Drawings.

2.8 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
1. Material: Steel.
2. Options:

a. Minimum Trade Size: trade size 3/4.
b. Colors: As indicated on Drawings.

2.9 TYPE LFNC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXOQ; including UL 1660.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXOQ - Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):
1. Additional Criteria: Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.
2. Options:

a. Minimum Trade Size: trade size 3/4.
b. Colors: As indicated on Drawings.
c. Markings: 90 deg C dry.

D. UL DXOQ - Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):

1. Additional Criteria: Type B conduit with smooth inner surface with integral reinforcement within conduit wall.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Colors: As indicated on Drawings.
    c. Markings: 90 deg C dry.

E. UL DXOQ - Corrugated (Type C) Liquidtight Flexible Nonmetallic Conduit (LFNC-C):
1. Additional Criteria: Type C conduit with corrugated internal and external surfaces without integral reinforcement within conduit wall.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Colors: As indicated on Drawings.
    c. Markings: 90 deg C dry.

2.10 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
1. Dimensional Specifications: Schedule 40.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Markings: For use with maximum 90 deg C wire.

D. UL DZYR - Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:
1. Dimensional Specifications: Schedule 80.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Markings: For use with maximum 90 deg C wire.

E. UL DZYR - Type A Rigid PVC Concrete-Encased Conduit (PVC-A) and Fittings:
1. Dimensional Specifications: Type A.
2. Options:

a. Minimum Trade Size: trade size 3/4.

2.11 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DWTT - Fittings for Type ERMC, Type IMC, Type PVC, and Type HDPE Duct Raceways:
1. Listing Criteria: UL CCN DWTT; including UL 514B.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL FKAV - Fittings for Type EMT Duct Raceways:
1. Listing Criteria: UL CCN FKAV; including UL 514B.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

E. UL ILNR - Fittings for Type FMC Duct Raceways:
1. Listing Criteria: UL CCN ILNR; including UL 514B.

F. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:
1. Listing Criteria: UL CCN DXAS; including UL 514B.

2.12 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

1. Send to engineer for review.

2.13 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DWTT - Solvent Cements for Type PVC Duct Raceways and Fittings:

1. Send to Engineer for review.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Special Instructions Regarding HDPE Conduits: Although Article 353 of NFPA 70 permits use of HDPE conduits where encased in concrete aboveground, UL CCN EAZX listing requirements state that HDPE underground conduits are intended only for use where direct buried with or without being encased in concrete. Specified Type HDPE underground conduits are not permitted to be used aboveground on Project.

C. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: ERMC.

a. Locations less than 2.5 m (8 ft) above finished floor.

3. Exposed and Not Subject to Physical Damage: ERMC, IMC, and Corrosion-resistant EMT.
4. Concealed Aboveground: ERMC, IMC, EMT.
5. Direct Buried: PVC-80, PVC-40, HDPE-80, and HDPE-40.
6. Concrete Encased Not in Trench: PVC-80, PVC-40.
7. Concrete Encased in Trench: PVC-80, PVC-40, HDPE-80, and HDPE-40.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Indoors:

1. Hazardous Classified Locations: ERMC.
2. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:

a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.

3. Exposed and Subject to Physical Damage: ERMC. Locations include the following:

a. Locations less than 2.5 m (8 ft) above finished floor.
b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: ERMC, IMC, EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: ERMC, IMC, EMT.
6. Damp or Wet Locations: ERMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

E. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ENT: Article 362 of NFPA 70 and NECA NEIS 102.
3. Type HDPE: Article 353 of NFPA 70 and NECA NEIS 111.
4. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
5. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
6. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
7. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
8. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.

9. Type LFNC: Article 342 of NFPA 70 and NECA NEIS 111.
10. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
11. Expansion Fittings: NEMA FB 2.40.
12. Consult Engineer for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

a. Complete duct raceway installation before starting conductor installation.
b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch (300 mm) of changes in direction.
d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:

1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2) Where an underground service duct raceway enters a building or structure.
3) Conduit extending from interior to exterior of building.
4) Conduit extending into pressurized duct raceway and equipment.
5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6) Where otherwise required by NFPA 70.

i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
j. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
k. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.

m. Install (2) pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

1) Termination fittings with shoulders do not require two locknuts.

o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERMC and IMC:

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

3. Type ERMC-S-PVC:

a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC duct raceway.
c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

4. Types FMC, LFMC, and LFNC:

a. Provide a maximum of 36 inch (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Types PVC and HDPE:

a. Do not install Type PVC or Type HDPE, conduit where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
b. Comply with manufacturer's published instructions for solvent welding and fittings.

6. Duct Raceways Embedded in Slabs:

a. Run duct raceways larger than metric designator 27 (trade size 1) below concrete slab. Where at right angles to reinforcement, place duct raceway close to slab support. Secure duct raceways to reinforcement at maximum 10 ft (3 m) intervals.
b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch (25 mm) of concrete without voids.
d. Do not embed threadless fittings in concrete unless locations have been specifically approved by Engineer.
e. Change from ENT to ERMC or IMC before rising above floor.

7. Stub-ups to Above Recessed Ceilings:

a. Provide EMT, IMC, or ERMC for duct raceways.
b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

8. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

9. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
b. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

10. Expansion-Joint Fittings:

a. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C)] temperature change.
2) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
3) Attics: 135 deg F (75 deg C) temperature change.

c. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
d. Install expansion fittings at locations where conduits cross building or structure expansion joints.

e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

11. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
12. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

    a. Provide warning signs.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 – BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables,

with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

2. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: Minimum 1.5 inch (38 mm).

D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: minimum 1.5 inch (38 mm).

F. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

G. UL QCIT - Metallic Raised-Floor Boxes and Floor Box Covers:

1. Description: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.

H. UL QCIT - Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.

I. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:

a. Degree of Protection: Type 1.

D. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:

a. Degree of Protection: Type 3R.

E. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:

a. Degree of Protection: Type 3R.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:
1. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
b. Wallplate Material: Galvanized steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

a. Type 3R unless otherwise indicated.
b. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
c. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

2. Indoors:

a. Type 1 unless otherwise indicated.
b. Damp or Dusty Locations: Type 12.
c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
d. Locations Exposed to Corrosive Agents: Type 4X.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.

3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
3. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
12. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.

13. Identification: Provide labels for boxes and associated electrical equipment.

    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each box with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates and covers.

3.5 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type PVC raceways and fittings.
2. Fittings for conduit, tubing, and cable.
3. Solvent cements.
4. Duct accessories.
5. Handholes and boxes for exterior underground wiring.
6. Duct sealing.
7. Communication wires - Trenwa Concrete Trench.

1.2 DEFINITIONS

A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.

B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.

C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.

D. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Duct-bank materials, including spacers and miscellaneous components.
2. Ducts, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, and boxes.
4. Underground-line warning tape.
5. Warning planks.

B. Shop Drawings:

1. Electric Utility Duct Banks and Structures:

a. Include plans, elevations, sections, and details, including attachments to other Work.
b. Indicate locations of private property boundaries and utility easements.

c. Include information required for approval by electric utility and for obtaining public space utility work permits.

2. Precast or Factory-Fabricated Concrete Structures:

a. Include plans, elevations, sections, and details, including attachments to other Work.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.
e. Include grounding details.
f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
g. Include joint details.

3. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. For concrete and steel used in precast concrete handholes, as required by ASTM C858.

B. Source Quality-Control Submittals:

1. Source quality-control reports.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts necessary for repairing or adding more cables to manholes or handholes that are packaged with protective covering for storage and identified with labels describing contents.

1.6 REGULATORY AGENCY APPROVALS

A. Shop Drawing submittals for electric utility duct banks and structures must be signed and sealed by qualified electrical professional engineer responsible for their preparation. Obtain approval by electric utility prior to submitting for action by Engineer.

PART 2 - PRODUCTS

2.1 TYPE EPEC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651A and UL CCN EAZX.

B. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Dimensional Specifications: Schedule 40.
2. Options:

    a. Minimum Trade Size: trade size 3/4.

C. Schedule 80 Electrical HDPE Underground Conduit (EPEC-80):

1. Dimensional Specifications: Schedule 80.
2. Options:

    a. Minimum Trade Size: trade size 3/4.

2.2 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Markings: For use with maximum 90 deg C wire.

C. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Dimensional Specifications: Schedule 80.
2. Options:

a. Minimum Trade Size: trade size 3/4.
b. Markings: For use with maximum 90 deg C wire.

2.3 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Metallic Fittings for Type Type PVC, Type HDPE:

1. General Characteristics: UL 514B and UL CCN DWTT.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.4 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

B. Solvent Cements for Type PVC Raceways and Fittings:

1. Send to Engineer for review.

2.5 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

C. Concrete Warning Planks: Nominal 12 by 24 by 3 inch (300 by 600 by 75 mm) in size, manufactured from 6000 psi (41 MPa) concrete.

1. Color: Red dye added to concrete during batching.
2. Mark each plank with "ELECTRIC" in 2 inch (50 mm) high, 3/8 inch (10 mm) deep letters.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. ASTM C858 for design and manufacturing processes.
    b. SCTE 77.

B. Source Quality Control:

1. Precast Concrete Utility Structures: Test and inspect in accordance with ASTM C1037.
2. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

    a. Tests of materials must be performed by independent testing agency.
    b. Strength tests of complete boxes and covers must be by independent testing agency or manufacturer. Qualified registered professional engineer must certify tests by manufacturer.

C. Precast Concrete Handholes and Boxes:

1. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.

2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Frame and Cover:

    a. Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
    b. Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
    c. Weatherproof steel frame, with concealed-hinge steel access door assembly; tamper-resistant, captive, cover-securing bolts; hold-open ratchet assembly; and recessed cover handle.
    d. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    e. Cover Legend: Molded lettering, "ELECTRIC".

4. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.

5. Handholes 12 inch wide by 24 inch long (300 mm wide by 600 mm long) and larger must have inserts for cable racks and pulling-in irons installed before concrete is poured.

D. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.

2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.

   a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
   b. Cover Legend: Molded lettering, "ELECTRIC".

4. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
5. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
6. Handholes 12 inch wide by 24 inch long (300 mm wide by 600 mm long) and larger must have factory-installed inserts for cable racks and pulling-in irons.
7. Options:

   a. Color: Gray.

E. High-Density Polyethylene (HDPE) Boxes:

1. Description: Injection molded of HDPE or copolymer-polypropylene. Cover must be made of polymer concrete.

2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

   a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
   b. Cover Legend: Molded lettering, "ELECTRIC".

4. Options:

   a. Color: Gray.

2.7 DUCT SEALING

A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Compound must be capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.

B. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

2.8 COMMUNICATION WIRES - TRENWA CONCRETE TRENCH.

A. GENERAL SPECIFICATIONS.

SCOPE

Provide a precast concrete underground utility trench system (for communication cabling) as manufactured by Trenwa, Inc. (Patent #2862367); 1419 Alexandria Pike; Fort Thomas, KY 41075.

The precast components shall be designed to conform to requirements stated in ASTM C857-07 "Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures, ASTM C858-07 "Specifications for Underground Precast Concrete Utility Structures" and ACI-318 "Building Code Requirements for Structural Concrete and Commentary on Building Code Requirements in Structural Concrete".

MATERIALS

1. Cement shall conform to ASTM C150/C150M, "Specification for Portland Cement".
2. Fine and coarse aggregates shall conform to ASTM C33/C33M, "Specification for Concrete Aggregates".
3. Chemical Admixtures shall conform to ASTM C260/C260M "Air-Entraining Admixtures for Concrete and ASTM C494/C494M "Chemical Admixtures for Concrete".
4. Steel reinforcing bars shall conform to ASTM A615 "Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement".
5. Steel reinforcing wires shall conform to ASTM A496 "Specification for Steel Wire, Deformed, for Concrete Reinforcement".
6. Steel reinforcing welded wire mats shall conform to A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete".
7. Embedded steel shapes and plates shall conform to ASTM A36/C36M "Standard Specification for Carbon Structural Steel".

CONCRETE

Batching, mixing and placing of concrete shall conform to ACI A301 "Specifications for Structural Concrete" and ASTM C94/C94M "Specification for Ready-Mix Concrete" and ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete". All materials shall be pre-weighed prior to mixing.

Concrete shall obtain a minimum compressive strength of 5,000 psi at 28 days of age.

Concrete shall contain 6% entrained air by volume (plus or minus 1%).

REINFORCEMENT

Fabrication and placement shall conform to ACI-318 "Building Code Requirements for Structural Concrete".

B. ROAD CROSSING TRENCH SPECIFICATION

1. The trench system will consist of precast concrete U-shaped bases and removable covers, manufactured by Trenwa, and installed in earth trenches with covers extending above the surrounding crushed rock surface.
2. All sections of trench designated for road crossing use will be designed to carry HS20, 32,000 pound axle loading and will be furnished in standard 10 foot lengths, except that special lengths will be furnished where required by the layout on the drawings.
3. The lids for the road crossing trench will be made of Steel Reinforced Concrete designed to carry HS20, 32,000 pound axle loading.
4. The interior clear cross sectional area for the road crossing bases will be at least 24" wide x 12" deep.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Engineer if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Engineer.

3.2 SELECTION OF UNDERGROUND DUCTS

A. Duct for Electrical Cables More Than 600 V: PVC-80, PVC-40, concrete encased unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less:PVC-80, PVC-40, direct buried unless otherwise indicated.

C. Duct for Electrical Branch Circuits: PVC-80, PVC-40, direct buried unless otherwise indicated.

D. Underground Ducts Crossing Paved Paths, Walks, and Driveways: PVC-80 direct buried.

E. Stub-ups: Concrete encased, RMC-S, IMC.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

A. Handholes and Boxes:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-10] [Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested in accordance with SCTE 77 with 3000 lbf (13 345 N) vertical loading.
5. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Restore area immediately after backfilling is completed.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Engineer for resolution of conflicting requirements.

B. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Slope: Pitch duct minimum slope of 1:300 down toward handholes and away from buildings and equipment.
3. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to handhole.
4. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch (19 mm).
5. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of

adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete for minimum of 12 inch (300 mm) on each side of coupling.

a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch (300 mm) below grade or floor level and do not terminate in hubs.

6. Duct Terminators for Entrances to Cast-in-Place Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inch (150 mm) o.c. for 4 inch (100 mm) duct, and vary proportionately for other duct sizes.

a. Begin change from regular spacing to terminator spacing 10 ft (3 m) from terminator, without reducing duct line slope and without forming trap in line.

7. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft (3 m) outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
8. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete for minimum of 12 inch (300 mm) on each side of coupling.

9. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig (1.03 MPa) hydrostatic pressure.
10. Pulling Cord: Install (2) 200 lbf (1000 N) test nylon cord in empty ducts.

11. Direct-Buried Duct and Duct Bank:

a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch (150 mm) in nominal diameter.
b. Width: Excavate trench 3 inch (75 mm) wider than duct on each side.
c. Depth: Install top of duct at least 36 inch below finished grade unless otherwise indicated.
d. Set elevation of top of duct bank below frost line.
e. Place minimum 3 inch (75 mm) of sand as bed for duct. Place sand to minimum of 6 inch (150 mm) above top level of duct.
f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
g. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 ft (6 m) of duct. Place spacers within 24 inch (600 mm) of duct ends. Stagger spacers approximately 6 inch (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

h. Install duct with minimum of 3 inch (75 mm) between ducts for like services and 6 inch (150 mm) between power and communications duct.
i. Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
j. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.

1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete.
2) Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

a) Stub-ups must terminate in coupling installed flush with finished base and minimum 3 inch (75 mm) from conduit side to edge of base.

3) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
4) Stub-ups through interior floors must terminate in coupling installed flush with finished floor and no less than 3 inch (75 mm) from conduit side to edge of equipment pad or floor slab.

k. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

12. Warning Planks: Bury warning planks approximately 12 inch (300 mm) above direct-buried duct, placing them 36 inch (900 mm) o.c. Align planks along width and along centerline of duct or duct bank. Provide additional plank for each 12 inch (300 mm) increment of duct-bank width over nominal 18 inch (450 mm). Space additional planks 12 inch (300 mm) apart, horizontally across width of ducts.
13. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch (300 mm) above concrete-encased duct and duct banks and approximately 12 inch (300 mm) below grade. Align tape parallel to and within 3 inch (75 mm) of centerline of duct bank. Provide additional warning tape for each 12 inch (300 mm) increment of duct-bank width over nominal 18 inch (450 mm). Space additional tapes 12 inch (300 mm) apart, horizontally across width of ducts.
14. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Engineer for resolution of conflicting requirements.

B. Special Techniques:

1. Precast Concrete Handholes:

   a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
   b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch (25 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
   c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

2. Elevations:
   a. Install handholes with bottom below frost line below grade.
   b. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
   c. Where indicated, cast handhole cover frame integrally with handhole structure.
3. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and insulators, as required for installation and support of cables and conductors and as indicated.
4. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 2 inch (50 mm) for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
5. Ground handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
4. Install handholes and boxes with bottom below frost line below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as

indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.

    a. Concrete: 3000 psi (20 kPa), 28-day strength with troweled finish.
    b. Dimensions: 10 inch wide by 12 inch deep (250 mm wide by 300 mm deep).

8. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch (300 mm) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

C. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

D. Assemble and submit test and inspection reports.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260543

SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:
1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:
1. General Characteristics:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inch (1270 mm) and with no side larger than 16 inch (400 mm), thickness must be 0.052 inch (1.3 mm).
2) For sleeve cross-section rectangle perimeter not less than 50 inch (1270 mm) or with one or more sides larger than 16 inch (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE-SEAL SYSTEMS

A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

2.4 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 POURABLE SEALANTS

A. Performance Criteria:

1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.

a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

4. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch (50 mm) above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

Install 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.

END OF SECTION 260544

SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-Installed concrete anchors.
6. Concrete inserts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load capacity for each seismic and wind-load-restraint device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic and wind-load-restraint component used.
3. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an agency acceptable to authorities having jurisdiction.
4. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. 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.

C. Delegated Design Submittal for Each Seismic-Restraint Device: Signed and sealed by qualified structural professional engineer.

1. For each seismic-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:

a. Seismic Restraints: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for seismic reinforcement use.

c. Seismic Design Calculations: Submit input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.

D. Delegated Design Submittal for Each Wind-Load Protection Device: Signed and sealed by qualified structural professional engineer.

1. For each wind-load protection device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:

a. Wind-Load Restraint: Select wind-load restraints complying with performance requirements, design criteria, and analysis data.
b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated wind loads. Include certification that device is approved by an NRTL for reinforcement use.
c. Wind-Load Design Calculations: Submit static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.

2. Seismic and Wind-Load-Restraint Detail Drawings: Signed and sealed by qualified structural professional engineer.

a. Design Analysis: To support selection and arrangement of seismic and wind-load restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint details with wind-load details required for equipment mounted outdoors.

3. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Earthquake Design Data (Ie):	1.5
Seismic Importance Factor:	Ss = 0.247g ; S1=0.056g
Site Class:	D
Spectral Response Coefficients:	Sds = 0.263g ; Sd1 = 0.089g
Seismic Design Category (SDC):	C
Basic Seismic Force Resisting System:	Special Reinforced
Response Coefficient (CS):	0.1976
Design Base Shear:	663 kips
Response Modification Factor (R):	5.0
Over strength Factor (ohm):	2.5
Analysis Procedure:	Equivalent Lateral Force

Ultimate design wind speed:	135 mph
Expose Category:	B
Internal Pressure Coefficient (Cp)	+-0.18
Component and Cladding (C&C)	Per ASCE 7-16

A. Delegated Design: Engage qualified structural professional engineer to design seismic and wind-load control system in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."

B. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component will not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

E. Component Supports:

1. Load ratings, features, and applications of reinforcement components must be based on testing standards of a nationally recognized testing agency.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.

3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
4. Surface Pattern: Smooth, ribbed, or waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

    a. Surface Pattern: Smooth, ribbed, or waffle pattern.
    b. Infused nonwoven cotton or synthetic fibers.

2.3 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.4 RESTRAINTS - CABLE TYPE

A. Seismic- and Wind-Load-Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.5 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:
   1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:
   1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.

   1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
   2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp (7.46 kW) that is not vibration isolated.

   1. Undercut expansion anchors are permitted.

2.7 CONCRETE INSERTS

A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.

B. Comply with MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static[, wind-load,] and seismic loads within specified loading limits.

3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

A. Provide seismic restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

C. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.

D. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
2. Install seismic-restraint and wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
2. Install seismic-restraint and wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
3. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
4. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer 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. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.

C. Nonconforming Work:

1. Seismic controls will be considered defective if they do not pass tests and inspections.
2. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION 260548

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft (2.3 m) above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.

3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color must be factory applied.
2. Colors for 208Y/120 V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 240 V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.

4. Colors for 480Y/277 V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and signs must 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 3 FEET MINIMUM."

E. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4 inch (100 mm) wide black stripes on 10 inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.

D. Floor Marking Tape: 2 inch (50 mm) wide, 5 mil (0.125 mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
   1. Tape:

      a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape must be permanent and may not be damaged by burial operations.
      c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

   2. Color and Printing:

      a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
      b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
      c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch (25 mm).

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

2.7 SIGNS

A. Metal-Backed Butyrate Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch (1 mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
   2. 1/4 inch (6.4 mm) grommets in corners for mounting.
   3. Nominal Size: 10 by 14 inch (250 by 360 mm).

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   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, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."
4. Others.

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

N. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high label; where two lines of text are required, use labels 2 inch (50 mm) high.

Q. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in common trench exceeds 16 inch (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose and plenum-rated cable ties.

X. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose and plenum-rated cable ties.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.

G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

2. 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.
    c. Others.

L. Arc Flash Warning Labeling: Self-adhesive labels.

M. Operating Instruction Signs: Self-adhesive labels.

N. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

O. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Stenciled legend 4 inch (100 mm) high.
3. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power-transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery racks.
    t. Power-generating units.
    u. Monitoring and control equipment.
    v. UPS equipment.

END OF SECTION 260553

SECTION 260573.13 – SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

1.2 DEFINITIONS

A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

E. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Short-circuit study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Comply with IEEE 399 and IEEE 551.

B. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.

D. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.

3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. 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.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support short-circuit study. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for Project's overcurrent protective devices 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. Obtain electrical power utility impedance at service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

9. Motor horsepower and NEMA MG 1 code letter designation.
10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 – COORDINATION STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.2 DEFINITIONS

A. 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. Existing to remain items must remain functional throughout construction period.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when abnormal current flow exists and then removes the affected portion of the circuit from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

F. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Coordination Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Coordination-study input data, including completed computer program input data sheets.
b. Study and equipment evaluation reports.

c. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for coordination study requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for coordination study require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Comply with IEEE 242 and IEEE 399.

B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

    a. Arcing faults.
    b. Simultaneous faults.
    c. Explicit negative sequence.
    d. Mutual coupling in zero sequence.

D. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Revisions to electrical equipment required by study.
7. Study Input Data: As described in "Power System Data" Article.

    a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.

    a. Phase and Ground Relays:

        1) Device tag.
        2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3) Recommendations on improved relaying systems, if applicable.

    b. Circuit Breakers:

        1) Adjustable pickups and time delays (long time, short time, and ground).

2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: 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 switching schemes and for emergency periods where power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying portion of system covered.
2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
3. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.
b. Medium-voltage equipment overcurrent relays.
c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. Largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

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 of the Work. 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. Obtain data necessary for conduct of overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other 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. Electrical power utility impedance at service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line 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. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator 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 root mean square (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. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Begin analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Transformer Primary Overcurrent Protective Devices:

1. Device must not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

I. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.

J. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

K. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

L. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Include in report identification of protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

A. Perform motor-starting study to analyze transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze effects of motor starting on power system stability.

B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.

END OF SECTION 260573.16

SECTION 260573.19 – ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS

A. 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.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

E. SCCR: Short-circuit current rating.

F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

G. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form:

a. Arc-flash study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for arc-flash hazard analysis requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for arc-flash hazard analysis require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Comply with IEEE 1584 and NFPA 70E.

B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

D. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.

8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch (76 by 127 mm) self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
3. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from 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.

3.3 POWER SYSTEM DATA

A. Obtain data necessary for conduct of arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.

2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

3.4 LABELING

A. Apply one arc-flash label on front cover of each section of equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below must have arc-flash label applied to it:
1. Low-voltage switchgear.
2. Switchboards.
3. Panelboards.
4. Motor-control centers.
5. Low voltage transformers.
6. Safety switches.
7. Control panels.
8. ATS.

C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment connected to Normal electrical systems, including the following:
   a. Primary service electrical systems.
   b. Distribution and branch-circuit panelboards.
   c. Lightning protection systems.
   d. Grounding systems.

2. Electrical equipment connected to Essential electrical systems that provide an alternative source of power in the absence of power from the Normal electrical system, including the following:
   a. Distribution and branch-circuit panelboards.
   b. Lighting protection systems.
   c. Grounding systems.
   d. Generators.
   e. UPS.
   f. ATS.

3. Controls and instrumentation, including the following:

   a. Equipment monitoring systems.
   b. Electrical metering and metering system.
   c. Lighting control systems.
   d. Security systems.
   e. Fire-alarm systems.

4. Systems testing and verification, including Normal and Essential electrical systems, and transitions from Normal to Essential electrical systems and back.

1.2 DEFINITIONS

A. BoD: Basis-of-Design Document.

B. Cx: Commissioning.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements.

E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Construction Checklists by Contractor: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for construction checklists:

1. Instrumentation and control for electrical systems.
2. Instrumentation and control for lighting control systems.
3. Low-voltage power cables.
4. Control voltage power cables.
5. Electrical feeders and branch circuits.
6. Switchboard assemblies rated 1200 A or greater.
7. Metal-enclosed bus duct.
8. Busway.
9. Low-voltage motor starters.
10. Low-voltage insulated case circuit breakers.
11. Low-voltage surge protective devices.
12. Medium-voltage power cables.
13. Metering devices.
14. Molded-case circuit breakers.
15. Low-voltage power circuit breakers.
16. Grounding systems.
17. Panelboards.
18. Receptacles and devices.
19. Engine generators.
20. Automatic transfer switches.
21. Variable-frequency drives.
22. AC synchronous motors and generators.
23. AC induction motors.
24. Battery systems.
25. Battery chargers.
26. UPS systems.
27. Lighting.

1.4 QUALITY ASSURANCE

A. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

a. Equipment/instrument identification number.
b. Planned Cx application or use.
c. Manufacturer, make, model, and serial number.

d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation must meet the following criteria:

a. Capable of testing and measuring performance within the specified acceptance criteria.
b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
c. Be maintained in good repair and operating condition throughout duration of use on Project.
d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

B. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.

3.2 GENERAL TESTING REQUIREMENTS

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.

1. Contributors to development of construction checklists must include, but are not limited to, the following:

a. Electrical systems and equipment installers.

G. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.

3.3 Cx TESTS FOR ELECTRICAL SYSTEMS

A. Verification of Normal Electrical System Operation:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal electrical system.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Normal electrical system.
4. Test Conditions: Energize components of Normal electrical system, one at a time.
5. Acceptance Criteria: Proper operation of Normal electrical system over a 48-hour period.

B. Verification of Essential Electrical System Operation:

1. Prerequisites:

   a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential electrical system.
   b. Completion of "Verification of Normal Electrical System Operation" tests.

2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Essential electrical system.
4. Test Conditions:

   a. Energize components of Normal electrical system.
   b. Simulate a failure of Normal electrical system.

5. Acceptance Criteria: Transfer of power from Normal to Essential electrical system within OPR.

C. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential electrical systems.

D. Test Conditions:

1. Energize components of Normal electrical system.
2. Test operation of equipment.

E. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 260800

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic time switches.
2. Indoor occupancy and vacancy sensors.
3. Lighting contactors.
4. Emergency shunt relay.
5. Conductors and cables.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20 A ballast load, 120/240 V(ac).
4. Programs:
   a. Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays].
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy] sensors.
2. Passive infrared, Ultrasonic, Dua] technology.
3. Separate] power pack.
4. Hardwired connection to switch.
5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
10. Mounting:

    a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    b. Relay: Externally mounted through a 1/2 inch (13 mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.

B. PIR Type: Wall and Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6 inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch (23 200 sq. mm).
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft. (27.4 m) when mounted on a 10 ft. (3 m) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. (110 sq. m) when mounted 48 inch (1200 mm) above finished floor.

C. Ultrasonic Type: Wall and Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 ft. (27.4 m) when mounted on a 10 ft. (3 m) high ceiling in a corridor not wider than 14 ft. (4.3 m).

6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. (110 sq. m) when mounted 84 inch (2100 mm) above finished floor.

D. Dual-Technology Type: Wall and Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch (23 200 sq. mm), and detect a person of average size and weight moving not less than 12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. (110 sq. m) when mounted 48 inch (1200 mm) above finished floor.

2.3 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.4 EMERGENCY SHUNT RELAY

A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

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 systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Tenant.

B. Tests and Inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Nonconforming Work:

1. Lighting control devices will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to supervise field tests and inspections.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

END OF SECTION 260923

SECTION 262413 – SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Switchboards.
2. Overcurrent protective devices.
3. Surge protection devices.
4. Ground-fault protection devices.
5. Accessories.
6. Other components.
7. 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. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than UL 50E, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. 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.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field Quality-Control Reports:

a. Test procedures used.
b. Test results that comply with requirements.
c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Handling, storing, and providing temporary heat.
2. Mounting accessories and anchoring devices.
3. Testing and adjusting overcurrent protective devices.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. 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.
2. 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.
3. 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.

4. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.7 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 in accordance with NECA 400 or NEMA PB 2.1.

1.8 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed switchboard perform in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Manufacturers: Eaton, Square D, Siemens, Engineer Approved Equal.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. 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.

D. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: 208Y/120 V.

J. Main-Bus Continuous: 1600 A.

K. Indoor Enclosures: Steel, UL 50E, Type 1.

L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.

M. Barriers: Between adjacent switchboard sections.

N. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

O. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.

P. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable 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. Coordinate with PSEG of Long Island.

Q. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

R. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

S. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
2. Phase- and Neutral-Bus Material:

    a. Hard-drawn copper of 98 percent conductivity, silver-plated.
    b. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.

Retain one of first two subparagraphs below for circuit-breaker line connection material. Copper connections from aluminum bus are not usually available.

3. Copper feeder circuit-breaker line connections.
4. Ground Bus: 1/4 by 2 inch (6 by 50 mm-) Minimum-size required by UL 891,] hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors.

5. 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.
6. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.

7. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

T. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Eaton, Square D, Siemens, Engineer Approved Equal.

B. SPDs: Listed and labeled in accordance with UL 1449, Type 2.

C. Features and Accessories:
1. Internal thermal protection that disconnects SPD before damaging internal suppressor components.
2. Indicator light display for protection status.
3. Form-C contacts rated at 5 A and 250 V(ac), one normally open and one normally closed, for remote monitoring of protection status.
4. Surge counter.

D. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 200 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits may not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 200 kA.

G. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): 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 adjustments.
    d. Ground-fault pickup level, time delay, and I squared t 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 double-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. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression 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: Remote-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: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "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: Two SPDT switches 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 must be removable only when circuit breaker is in off position.

B. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on switch blade after it engages stationary contacts.
    1. Manufacturers: Eaton, Square D, Siemens, Engineer Approved Equal.
    2. Main-Contact Interrupting Capability: Minimum of 12 times 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, SPDT, 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.

    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 cumulative value of intermittent arcing ground-fault currents and uses 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).

6. Open-Fuse Trip Device: Arranged to trip switch open if phase fuse opens.

2.4 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

    a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    d. Megawatts: Plus or minus 1 percent.
    e. Megavars: Plus or minus 1 percent.
    f. Power Factor: Plus or minus 1 percent.
    g. Frequency: Plus or minus 0.1 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
    j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits:

1. 120 V(ac), supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards in accordance with NECA 400 or NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage in accordance with manufacturer's published instructions.

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 or that affect performance of equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 400 or NEMA PB 2.1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Equipment Mounting: Install switchboards on concrete base, 4 inch (100 mm) nominal thickness. Comply with requirements for concrete base specified in Section 260529 "Hangers and Supports for Electrical Systems."

    a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch (50 mm) above concrete base after switchboard is anchored in place.
    b. 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 concrete base.
    c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.
    e. Install anchor bolts to elevations required for proper attachment to switchboards.
    f. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Operating Instructions: Frame and mount 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.
5. Install filler plates in unused spaces of panel-mounted sections.
6. Install overcurrent protective devices, surge protection devices, and instrumentation.

    a. Set field-adjustable switches and circuit-breaker trip ranges.

7. Install spare-fuse cabinet.

3.4 CONNECTIONS

A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.

B. Support and secure conductors within switchboard in accordance with NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "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 nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

3.6 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Acceptance Testing:

    a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. 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 infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Nonconforming Work:

1. Switchboard will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 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 Section 260573.16 "Coordination Studies."

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION 262413

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. 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.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.

9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.]

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. 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.
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.

1.7 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.

B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

1.8 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. 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.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: UL 50E, Type 1.
b. Outdoor Locations: UL 50E, Type 3R.

2. Height: 7 ft (2.13 m) maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
4. Finishes:

a. Panels and Trim: Steel and galvanized 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.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating must run entire length of bus.
    b. Bus must be fully rated for entire length.

2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations must allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 10 percent.

J. Panelboard Short-Circuit Current Rating:

Retain one or both subparagraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment.

1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.

    a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

    a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

K. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.2 POWER PANELBOARDS

A. Listing Criteria: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inch (914 mm) high, provide two latches, keyed alike.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Column-Type Panelboards: Single row of overcurrent devices.

1. Column-Type Panelboard Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. 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:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Equipment Mounting:
   a. Attach panelboard to vertical finished or structural surface behind panelboard.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Mount top of trim 7ft above finished floor unless otherwise indicated.
4. Mount panelboard cabinet plumb and rigid without distortion of box.
5. Install overcurrent protective devices and controllers not already factory installed.

   a. Set field-adjustable, circuit-breaker trip ranges.
   b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

6. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
7. Install filler plates in unused spaces.

8. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
9. Mount spare fuse cabinet in accessible location.

C. Interfaces with Other Work:

1. 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.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

G. Circuit Directory:

1. Provide directory card inside panelboard door, mounted in transparent card holder.

   a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

   a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Field tests and inspections must be witnessed by Tenant.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. 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 infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Instruments and Equipment:

1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. 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 Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.
4. Locking receptacles.
5. Connectors, cords, and plugs.

1.2 DEFINITIONS

A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Key lock switches.
3. Momentary-contact switches.
4. Dimmer switches.
5. Duplex straight-blade receptacles.
6. Receptacles with AFCI device.
7. Receptacles with GFCI device.
8. Locking receptacles.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Dimmers.

2. Fan-speed controllers.
3. Single straight-blade receptacles.
4. Duplex straight-blade receptacles.
5. Duplex straight-blade receptacles with integral switching means.
6. Hospital-grade straight-blade receptacles.
7. Receptacles with AFCI device.
8. Receptacles with GFCI device.
9. Locking receptacles.

B. Sample warranties.

1.5 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN WMUZ and UL 20.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Extra-heavy-duty, 120-277 V, 20 A, single pole & three way.

B. Toggle Switch with Forked Key Lock:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN WMUZ and UL 20.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:

Retain one of three subparagraphs below.

1) 120-277 V, 20 A, single pole & three way.

C. Type I Dimmer Switch:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN EOYX and UL 1472 Type I dimmer.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Switch Style: Toggle.
c. Dimming Control Style: Slide.

.

d. Device Color: As indicated on architectural Drawings.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:

Retain one of first 13 subparagraphs below.

1) Extra-heavy-duty, NEMA 5-20R.

B. Tamper-Resistant Duplex Straight-Blade Receptacle:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. General Characteristics:
      a. Reference Standards: UL CCN RTRT and UL 498.
   3. Options:
      a. Device Color: As indicated on architectural Drawings.
      b. Configuration:
         1) Extra-heavy-duty, NEMA 5-20R.

C. Tamper-Resistant Duplex Straight-Blade Receptacle with USB Outlet to Power Class 2 Equipment:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. General Characteristics:
      a. Reference Standards: UL CCN RTRT and UL 498.
   3. Options:
      a. Device Color: As indicated on architectural Drawings.
      b. Configuration:

Retain one of first five subparagraphs below.

1) General-duty, NEMA 5-20R; one USB-A port; one USB-C port.

2.3 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device <Insert drawing designation>:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration: Heavy-duty, NEMA 5-20R.

2.4 LOCKING RECEPTACLES

A. NEMA, 125 V, Locking Receptacle:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: Black with yellow voltage indication on face.
b. Configuration: 2 pole, 3 wire, grounding, NEMA L5-30R.

B. NEMA, 250 V, Locking Receptacle:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: Black with blue voltage indication on face.
b. Configuration:

1) 2 pole, 3 wire, grounding, NEMA L6-30R.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF LOCKING RECEPTACLES

A. Comply with manufacturer's instructions.

B. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

C. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.7 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.8 SYSTEM STARTUP FOR SWITCHES

A. Perform startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

3.9 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.2 DEFINITIONS

Retain definition(s) remaining after this Section has been edited.

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. GFLS: Ground-fault circuit-interrupter for life safety.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
7. 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. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 V(ac).
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, 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.

1. Equipment Ground Kit: 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Lugs: Compression type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

B. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over

center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

If series rated breakers are not allowed, delete the references to series rated in first paragraph below.

C. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated or series rated as indicated on Drawings.

D. MCCBs must be equipped with device for locking in isolated position.

E. Lugs must be suitable 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.

F. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application.
3. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1) and gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (UL 50E Types 3R, 12.

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: Circuit-breaker operating handle must be directly operable through front cover of enclosure (UL 50E Type 1) and directly operable through dead front trim of enclosure (UL 50E Type 3R).

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.

1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

C. Other Wet or Damp, Indoor Locations: UL 50E, Type 3R.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. 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.
2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
4. Install fuses in fusible devices.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "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.

3.5 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's

published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

C. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that unit is clean.
e. Operate circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of

manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.

3. Test and adjust controls, remote monitoring, and safeties.

D. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 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 Section 260573.16 "Coordination Studies."

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.

1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

SECTION 263213.16 – GAS-ENGINE DRIVER GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Engine.
2. Gas fuel system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor generator-set enclosure.
7. Vibration isolation devices.

1.2 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. LP: Liquefied petroleum.

D. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in cubic feet per hour (cubic meters per hour) at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95 deg F (35 deg C), 80 deg F (27 deg C), 70 deg F (21 deg C), and 50 deg F (10 deg C). Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
4. Report of sound generation.
5. Report of exhaust emissions showing compliance with applicable regulations.
6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Generac (basis of design), Kohler, and Cummins.

B. Source Limitations: Obtain packaged engine generators and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 1 EPSS.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F.
2. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.

C. Power Rating: Standby.

"Overload Capacity" Paragraph below is only applicable if "prime" option is retained above.

D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.

Retain "EPSS Class" Paragraph below if retaining "standby" option in "Power Rating" Paragraph above. "Class," as used in "EPSS Class" Paragraph below, refers to the number of hours the EPSS is required to operate at full load without refueling. Coordinate with seismic design criteria. NFPA 110 requires seismic Categories C, D, E, and F to have a minimum 96-hour fuel supply for Level 1 engine generators.

E. Service Load: 500 kVA.

F. Power Factor: 0.8, lagging.

G. Frequency: 60 Hz.

H. Voltage: 208 V ac.

I. Phase: Three-phase, four wire, wye.

J. Governor: Adjustable isochronous, with speed sensing.

K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

Coordinate "Capacities and Characteristics" Paragraph below with prototype test requirements in "Informational Submittals" Article and in "Source Quality Control" Article.

L. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:
    a. Comply with NFPA 110, Type 10 system requirements.

Retain subparagraph below for prime or industrial generators.

2.4 GAS ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid-mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499 and with NFPA 110 requirements for Level 1 equipment for heater capacity.

E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer:

1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

    a. Minimum sound attenuation of 25 dB at 500 Hz.
    b. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 65 dBA or less.

G. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GAS FUEL SYSTEM

A. Natural Gas Piping: Comply with requirements in Section 231123 "Facility Natural Gas Piping."

B. Engine Fuel System: Natural Gas.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates generator-set shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration:

1. Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:

a. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.

E. Control and Monitoring Panel:

1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

a. Engine lubricating-oil pressure gage.
b. Engine-coolant temperature gage.
c. DC voltmeter (alternator battery charging).
d. Running-time meter.
e. AC voltmeter, connected to a phase selector switch.
f. AC ammeter, connected to a phase selector switch.
g. AC frequency meter.
h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:

a. Cranking control equipment.
b. Run-Off-Auto switch.
c. Control switch not in automatic position alarm.
d. Overcrank alarm.
e. Overcrank shutdown device.
f. Low water temperature alarm.
g. High engine temperature prealarm.
h. High engine temperature.
i. High engine temperature shutdown device.
j. Overspeed alarm.
k. Overspeed shutdown device.
l. Low fuel main tank.

1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.

m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. EPS supplying load indicator.
t. Battery high-voltage alarm.
u. Low cranking voltage alarm.
v. Battery-charger malfunction alarm.
w. Battery low-voltage alarm.
x. Lamp test.
y. Contacts for local and remote common alarm.

z. Low-starting air pressure alarm.
aa. Low-starting hydraulic pressure alarm.
bb. Remote manual stop shutdown device.
cc. Air shutdown damper alarm when used.
dd. Air shutdown damper shutdown device when used.
ee. Hours of operation.
ff. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
gg. Generator overcurrent protective device not closed alarm.

F. Connection to Datalink:

1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet.

G. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low cranking voltage alarm.
19. Generator overcurrent protective device not closed.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:

1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:

   a. Tripping Characteristic: Designed specifically for generator protection.
   b. Trip Rating: Matched to generator output rating.
   c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
   d. Mounting: Adjacent to or integrated with control and monitoring panel.

2. Molded-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489:

   a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   b. Trip Settings: Selected to coordinate with generator thermal damage curve.
   c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
   d. Mounting: Adjacent to or integrated with control and monitoring panel.

3. Insulated-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489:

   a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   b. Trip Settings: Selected to coordinate with generator thermal damage curve.
   c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
   d. Mounting: Adjacent to, or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

Class H insulation in "Electrical Insulation" Paragraph below has a higher temperature rating than Class F. Class H insulation can give the alternator a longer life. Check with manufacturer to determine availability for the generator sized for the project loads.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12 lead alternator.

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 5 percent and stabilize at rated frequency within 2 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description:

1. Vandal-resistant, Level 2 sound-attenuating enclosure, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

a. Sound Attenuation Level: 65 dB at 25 feet (Level 2 Sound attenuating enclosure) .

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).

C. Hinged Doors: With padlocking provisions.

D. Space Heater: Thermostatically controlled and sized to prevent condensation.

E. Lighting: Provide weather-resistant LED lighting with 50 fc (550 lux) average maintained.

F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

G. Muffler Location: External to enclosure.

H. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

I. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.
2. DC lighting system for operation when remote source and generator are both unavailable.

J. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of 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. Minimum Deflection: 1 inch (25 mm).

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

B. Paint Color: Outdoor enclosure shall be factory painted a color as selected by owner.

C. Selection of Paint: Manufacturer shall provide to the owner a sample of the color via a paint color strip or in another form. The manufacturer shall send back a small painted metal piece for the approval of the paint color by the owner prior to painting the enclosure.

2.12 SOURCE QUALITY CONTROL

A. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Exhaust System: Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install flexible connectors and steel piping materials according to requirements in Section 232116 "Hydronic Piping Specialties."
2. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."

E. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe, the full size of the drain connection, with welded joints.

F. Gaseous Fuel Piping:

1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 231123 "Facility Natural Gas Piping."

G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.4 FIELD QUALITY CONTROL

A. Testing Agency:

1. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs below as specified in the NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests in accordance with IEEE 43.

            a) Machines larger than 200 hp (150 kW). Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp (150 kW) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Perform vibration test for each main bearing cap.
        6) Verify correct functioning of the governor and regulator.

2. 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.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. 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.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. 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.
6. 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.
7. Exhaust Emissions Test: Comply with applicable government test criteria.

8. 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.
9. 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.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at two locations 25 feet (8 m) from edge of the generator enclosure and on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. 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.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and reinspect as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. 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.

K. 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.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. 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.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.16

SECTION 263600 – TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Nonautomatic transfer switches.
3. Transfer switch accessories.

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 transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer-authorized service representative.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Features and operating sequences, both automatic and manual.
    b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

    a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Architect no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's written permission.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

J. Neutral Terminal: Solid and fully rated unless otherwise indicated.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

N. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: ASCO, Kohler, and Eaton.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Compression type.
7. Ground Lugs and Bus-Configured Terminators: Compression type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

H. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:

    a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

2.3 NONAUTOMATIC TRANSFER SWITCHES

A. Manufacturers: ASCO, Kohler, and Eaton.

B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Pilot Lights: Indicate source to which load is connected.

E. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."

F. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: Hard-drawn copper, 98 percent conductivity.
5. Main and Neutral Lugs: Compression type.
6. Ground Lugs and Bus-Configured Terminators: Compression type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

2.4 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
d. Transition:
   1) Provide open-transition operation when transferring between power sources.

e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
h. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

i. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Identify components according to Section 260553 "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

D. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.

G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:

1. Owner will engage qualified testing agency to administer and perform tests and inspections.

B. Tests and Inspections:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.

e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. 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.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
g. 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.

C. Coordinate tests with tests of generator and run them concurrently.

D. 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.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

H. 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.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. 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.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265119 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Luminaire types.
   2. Materials.
   3. Luminaire support.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests.

      a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.
    g. Wifi routers.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, 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.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.

3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

B. Ambient Temperature: 41 to 104 deg F.

2.2 LUMINAIRE REQUIREMENTS

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. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 LUMINAIRE TYPES

A. Refer to Architectural and Electrical drawings for the luminaire schedules for more information.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

   a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports.
   b. Hook mount.

2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 – EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting.
2. Exit signs.
3. Materials.
4. Luminaire support components.

1.2 DEFINITIONS

A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.

B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of emergency lighting unit, exit sign, and emergency lighting support.

a. Include data on features, accessories, and finishes.
b. Include physical description of unit and dimensions.
c. Battery and charger for light units.
d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

B. Shop Drawings:

1. For nonstandard or custom luminaires.

a. Include plans, elevations, sections, and mounting and attachment details.
b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams for power, signal, and control wiring.

C. Samples: For each product and for each color and texture specified.

D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.

E. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.

C. Sample Warranty: For manufacturer's warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.

1. Extended Warranty Period: Two year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with NFPA 101.

C. Comply with NEMA LE 4 for recessed luminaires.

D. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
   1. Nightlight Connection: Operate lamp continuously at 50 percent of rated light output.
   2. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   3. Battery: Sealed, maintenance-free, nickel-cadmium type.
   4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. General Characteristics: Self-contained units.

B. Emergency Luminaire: Refer to Architectural and Electrical drawings for the luminaire schedules for more information

2.3 EXIT SIGNS

A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Sign: Refer to Architectural and Electrical drawings for the luminaire schedules for more information

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components must be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

C. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

D. Ceiling Grid Mounted Luminaires:

1. Secure to outlet box, if provided.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect luminaires. Replace lamps, emergency power units batteries, exit signs, and luminaires that are defective.

a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

3.6 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Luminaire types.
   2. Materials.
   3. Finishes.
   4. Luminaire support components.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaire.
   4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type.

      a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

   6. Wiring diagrams for power, control, and signal wiring.
   7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, 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.

D. Product Certificates: For each type of the following:

1. Luminaire.

E. Source quality-control reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.8 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.

b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 3 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

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.

2.3 LUMINAIRE TYPES

A. Refer to Architectural and Electrical drawings for the luminaire schedules for more information.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color:

1) As selected from manufacturer's standard catalog of colors.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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 the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Selection and installation of communications busbars.
2. Selection and installation of communications bonding conductors.
3. Installation of grounding and bonding for towers and antennas.

1.2 DEFINITIONS

A. BBC: Backbone bonding conductor, for connecting multiple TBBs serving the same floor.

B. PBB: Primary bonding busbar, located in main distribution frame room, ideally near electrical service entrance.

C. RBB: Rack bonding busbar, located in equipment cabinets and racks.

D. SBB: Secondary bonding busbar, located in intermediate distribution frame rooms.

E. TBB: Telecommunications bonding backbone, for connecting SBBs to PBB.

F. TBC: Telecommunications bonding conductor, for connecting PBB to intersystem bonding termination device or busbar at electrical service entrance.

G. TEBC: Telecommunications equipment bonding conductor, for connecting RBBs to SBBs or PBB.

H. UBC: Unit bonding conductor, for connecting individual communications equipment to RBBs or SBBs.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. For communications equipment room signal reference grid.
2. Include plans, elevations, sections, details, and attachments to other work.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Installing wire connector on conductor.
2. Recommended torque values.

1.5 CLOSEOUT SUBMITTALS

A. Record Documentation: Project record documents in accordance with Section 017839 "Project Record Documents" must include locations of PBB and SBBs, and routing of TBC, TBBs, and BBCs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of TBC connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF COMMUNICATIONS BUSBARS

A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. PBB:

1. Dimensions: 1/4 inch thick by 8 inch high.
2. Stand-Off Distance: 2 inch.

C. SBB:

Indicate length of each SBB and its hole pattern on Drawings.

1. Dimensions: 1/4 inch thick by 4 inch high.
2. Stand-Off Distance: 2 inch.

3.3 SELECTION OF COMMUNICATIONS BONDING CONDUCTORS

A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Communications Busbar Connections:

For bonding conductor length up to 52 ft (16 m), use 1/0 AWG; if longer, use 3/0 AWG. Ideally, the length of the TBC should be less than 30 ft (9 m) because the impedance of this conductor limits its effectiveness.

1. TBC: Not smaller than 3/0 AWG and no smaller than largest TBB.
2. TBB: Not smaller than 2 kcmil per linear ft of conductor length, but not larger than 750 kcmil, unless otherwise indicated on Drawings.
3. BBC: Not smaller than largest TBB to which it is connected unless otherwise indicated on Drawings.
4. TEBC: Not smaller than 3/0 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
5. UBC: Not smaller than 3/0 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
6. Bonding Conductors to Structural Steel: Not smaller than 3/0 unless otherwise indicated on Drawings. Provide bolted clamp connectors.

C. Cable Tray Connections:

1. Cable Tray Equipment Grounding Conductor: 6 WG.

Retain first or second of each pair of options in "Cable Tray Bonding Jumper" Subparagraph below depending on the selection of the cable tray in Section 270536 "Cable Trays for Communications Systems." First option in each pair is for 10 AWG; second, for 6 AWG.

2. Cable Tray Bonding Jumper: If not supplied by cable manufacturer, provide bonding jumper not smaller than 6 AWG and not longer than 12 inch (300 mm). If jumper is wire, it must be terminated with lug having one hole and standard barrel for one crimp. If jumper is flexible braid, it must be terminated with one- or two-hole ferrule. Attach with bonding screw or connector provided by cable tray manufacturer.

D. Underground Connections: Not smaller than 3/0 AWG. Provide welded connectors, except bolted connectors may be used in handholes or manholes and as otherwise indicated on Drawings.

3.4 INSTALLATION OF BONDING FOR COMMUNICATIONS

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Bonding of Communications: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with BICSI N3.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Busbars:

    a. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 12 inch (300 mm) above finished floor unless otherwise indicated.
    b. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

2. Conductors:

    a. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
    b. Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows:

        1) Use crimping tool and die specific to connector.
        2) Pretwist conductor.
        3) Apply antioxidant compound to bolted and compression connections.

    c. Install in straightest and shortest route between origination and termination point, and no longer than required. Bend radius must not be smaller than 10 times diameter of conductor. No single bend may exceed 90 degrees.
    d. Install without splices.
    e. Support conductors at not more than 36 inch (900 mm) intervals.

3. Provide TBC and terminate ends to PBB and intersystem bonding busbar at electrical service entrance in accordance with Section 250.94, "Bonding for Communication Systems," of NFPA 70.
4. Busbar Interconnections: Bond SBBs to PBB with TBBs. If more than one TBB is installed, bond TBBs together BBCs where required by TIA-607.
5. Structural Steel: Where structural steel of steel frame building is readily accessible within room or space, bond each SBB and PBB to vertical steel of building frame.
6. Communications Enclosures: Bond metallic enclosures of telecommunications equipment with UBCs to nearest SBB or PBB.
7. Equipment Racks: Bond metallic components of enclosures to RBB using UBCs. Provide top-mounted RBB if not provided by enclosure or rack manufacturer. Bond RBB to SBB with TEBC. Power connection must comply with NFPA 70; equipment grounding conductor in power cord of cord- and plug-connected equipment must be considered supplemental to bonding requirements in this Section.
8. Shielded Cable: Bond shield of shielded cable to SBB in communications rooms and spaces. Comply with TIA-568.1 and TIA-568.2 when grounding shielded balanced twisted-pair cables.
9. Primary Protector: Bond to PBB with insulated bonding conductor.
10. Electrical Power Panelboards: Where electrical panelboards for communications equipment are located in same room or space, bond each ground bar of panelboard to SBB.
11. Cable Trays: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
12. Ladder Racks: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
13. Access Floors: Bond metal parts of access floors to SBB.

3.5 INSTALLATION OF GROUNDING AND BONDING FOR TOWERS AND ANTENNAS

A. Special Techniques:

1. Ring Electrode: Buried at least 30 inch (760 mm) below grade and at least 24 inch (610 mm) from base of tower or mounting.
2. Bond each tower base and metallic frame of dish to ring electrode, buried at least 18 inch (460 mm) below grade.
3. Bond ring electrode and antenna bonding conductors to equipment room PBB or SBB, buried at least 30 inch (760 mm) below grade.
4. Bond metal fences located within 6 ft (1.8 m) of towers and antennas to ring electrode, buried at least 18 inch (460 mm) below grade.
5. Special Requirements for Roof-Mounted Towers:

    a. Roof Ring: Meet requirements for ring electrode except conductors must comply with NFPA 780.
    b. Bond tower base footings steel, SBB in equipment room, and antenna support guys to roof ring.
    c. Connect roof ring to perimeter conductors of lightning protection system.

6. Special Requirements for Waveguides and Coaxial Cable:

    a. Bond cable shields at point of entry into building to nearest SBB and to cable entrance plate, using 2 AWG bonding conductors.
    b. Bond coaxial cable surge arrester to ring electrode or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.6 IDENTIFICATION

A. Comply with Section 270553 "Identification for Communications Systems."

B. Labels must be preprinted or computer-printed type.

1. Label PBB(s) with "ts-PBB," where "ts" is telecommunications space identifier for location of PBB.
2. Label SBB(s) with "ts-SBB," where "ts" is telecommunications space identifier for location of SBB.
3. Label TBC, TBBs, and BBCs at attachment points with legend: "WARNING! COMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.7 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction.

C. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench according to manufacturer's published instructions.
2. Test bonding connections of system using AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing PBB or SBB, using process recommended by BICSI N1. Conduct tests with facility in operation.

    a. Measure resistance between PBB and electrical service intersystem termination point. Maximum acceptable value is 100 mΩ.

        1) If measured resistance from electrical service equipment to ground exceeds 5 Ω, notify Architect and include recommendations to reduce resistance to ground.

    b. Measure resistance between SBBs and PBB. Maximum acceptable value is 100 mΩ.

3. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 A, displaying current in increments of 0.01 A at accuracy of plus or minus 2.0 percent.

    a. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to PBB and to SBBs. Maximum acceptable AC current level is 1 A.

D. Nonconforming Work:

1. Communications bonding will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

3.8 PROTECTION

A. After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 270526

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.2 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 the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Equipment supports.
5. 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.

C. Delegated-Design Submittal: For hangers and supports for communications systems.

1. Include design calculations and details of trapeze hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for communications equipment and systems, 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.

C. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. See Section 260548 for more information.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
   1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   2. Material for Channel, Fittings, and Accessories: Galvanized steel.
   3. Channel Width: Selected for applicable load criteria.
   4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
   7. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
   1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   2. Channel Material: 6063-T6 aluminum alloy.
   3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
   4. Channel Width: Selected for applicable load criteria.
   5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
   7. Channel Dimensions: Selected for applicable load criteria.

C. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications 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 made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. 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.

   2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325 (Grade A325M).
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

Consult structural engineer for requirements in this article.

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101.
5. NECA 102.
6. NECA 105.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) 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 50 percent in future without exceeding specified design load limits.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1,EMT, IMC, and RMC may be supported by openings through structure members, according to NFPA 70.

B. 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 (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To New Concrete: Bolt to concrete inserts.
   2. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   3. 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   4. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   5. To Light Steel: Sheet metal screws.
   6. 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 comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 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 (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 270529

SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ladder cable tray.
2. Wire-mesh cable tray.
3. Cable tray accessories.
4. Warning signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.
b. Clearances for access above and to sides of cable trays.
c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Data: Certificates, for cable trays, 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.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
2. Component Importance Factor: See Section 260548.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.

3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

A. Description:

1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: Indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches (75 mm).
4. Splicing Assemblies: Bolted type using serrated flange locknuts.
5. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
6. Covers: Louvered type made of same materials and with same finishes as cable tray.

B. Materials and Finishes:

1. Steel:

a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.

2. Aluminum:

a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 according to ANSI H35.1/H 35.1M for fabricated parts.
b. Hardware: Chromium-zinc-plated steel, ASTM F1136.
c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2.4 WIRE-MESH CABLE TRAY

A. Description:

1. Configuration: Galvanized- steel wire mesh, complying with NEMA VE 1.
2. Width: Indicated on Drawings.
3. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
4. Splicing Assemblies: Bolted type using serrated flange locknuts.
5. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

B. Materials and Finishes:

1. Steel:

    a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
    b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
    c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
    d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.

        1) Hardware: Galvanized, ASTM B633.

2.5 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1] [NEMA VE 1].

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

NEMA FG 1 applies to fiberglass cable trays only. NEMA VE 2 applies to all metallic cable trays.

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. Support wire-basket cable trays with center support hangers.

N. Support center support hangers for wire-basket trays with 1/4-inch- (6-mm-) diameter rods.

O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

P. Make changes in direction and elevation using manufacturer's recommended fittings.

Q. Make cable tray connections using manufacturer's recommended fittings.

R. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

S. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

T. Install cable trays with enough workspace to permit access for installing cables.

U. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

V. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

W. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

X. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Foam sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Wall Sleeves, Cast Iron:

1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness must be 0.052 inch (1.3 mm).

2) For sleeve cross-section rectangle perimeter not less than 50 inches (1270 mm) or with one or more sides larger than 16 inches (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable or between pathway and cable.

1. Pressure Plates:Carbon steel.
2. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless sleeve seal system is to be installed or seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

D. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations:

1. Install cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

END OF SECTION 270544

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Underground-line warning tape.
2. Signs.
3. Bands and tubes.
4. Cable ties.
5. Miscellaneous identification products.
6. Labels.

1.2 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 communications identification products.

B. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.
4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels:
a. Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground 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 degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE" .

C. Tag, Detectable: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, 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.
2. Width: 3 inches (75 mm).
3. Overall Thickness: 5 mils (0.125 mm).
4. Foil Core Thickness: 0.35 mil (0.00889 mm).
5. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
6. Tensile according to ASTM D882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).

2.6 SIGNS

A. Baked-Enamel Signs:
1. Preprinted aluminum signs, high-intensity reflective,]punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated-Acrylic or Melamine-Plastic Signs:
1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.
d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
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, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.

G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

H. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
3. Provide label 6 inches (150 mm) from cable end.

I. Snap-Around Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

J. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

K. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

L. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

M. Underground-Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

N. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:

a. Telecommunications.

D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:

1. Wiring closet designation.
2. Colon.
3. Faceplate number.

E. Equipment Room Labeling:

1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
2. Patch Panels: Label individual rows in each rack, starting at top and working down, with self-adhesive labels.
3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:

a. Room number being served.
b. Colon.
c. Faceplate number.

F. Backbone Cables: Label each cable with a vinyl-wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

G. Horizontal Cables: Label each cable with a vinyl-wraparound label indicating the following, in the order listed:

1. Room number.
2. Colon.
3. Faceplate number.

H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

I. Instructional Signs: Self-adhesive labels.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

K. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Equipment to Be Labeled:

a. Communications cabinets.
b. Uninterruptible power supplies.
c. Computer room air conditioners.
d. Fire-alarm and suppression equipment.
e. Egress points.
f. Power distribution components.

END OF SECTION 270553

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Boxes, enclosures, and cabinets.
3. Power strips.

B. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

C. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

D. TGB: Telecommunications grounding bus bar.

E. TMGB: Telecommunications main grounding bus bar.

1.2 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 equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. 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. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Data: Certificates, 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. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment 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 when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

B. Backboard Paint: Pre-painted.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Hinged-Cover Enclosures: Comply with UL 50 and 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. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

F. 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.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with integral flanges.
3. Housing: Metal.
4. [8], 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
5. Front-facing receptacles.
6. LED indicator lights for power and protection status.
7. LED indicator lights for reverse polarity and open outlet ground.
8. Circuit Breaker and Thermal Fusing:

    a. When protection is lost, circuit opens and cannot be reset.

9. Cord connected with 15-foot (4.5-m)] line cord.
10. Rocker-type on-off switch, illuminated when in on position.
11. Surge Protection: UL 1449, Type 3.

    a. Maximum Surge Current, Line to Neutral: 65 kA.
    b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
    c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V value.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

C. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

E. Backboards:

1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

END OF SECTION 271100

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm remote annunciators.
10. Fire-alarm addressable interface devices.
11. Digital alarm communicator transmitters (DACTs).

1.2 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. EMT: Electrical metallic tubing.

C. FACU: Fire-alarm control unit.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.3 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Annunciator panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification-appliance circuits.
7. Include battery-size calculations.
8. Include input/output matrix.
9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
10. Include performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Qualification Statements: For Installer.

C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

   a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
   b. Provide "Fire-Alarm System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
   c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
   d. Riser diagram.
   e. Device addresses.
   f. Record copy of site-specific software.
   g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

      1) Equipment tested.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Requirements and recommendations related to results of maintenance.
      5) Manufacturer's user training manuals.

   h. Manufacturer's required maintenance related to system warranty requirements.
   i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm Level IV technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

Retain one of first two options in first subparagraph below. System in first option is a quality-assurance program described in NFPA 72 and administered by UL. System in second option is a similar program administered by FM Global. See Editing Instruction No. 1 in the Evaluations for discussion about UL certification and FM Global placards. Coordinate with Drawings.

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:

a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

a. Automatic sensitivity control of certain smoke detectors.
b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

1) Manual stations.
2) Heat detectors.
3) Smoke detectors.
4) Duct smoke detectors.
5) Carbon monoxide detectors.
6) Combustible gas detectors.
7) Automatic sprinkler system water flow.
8) Fire standpipe system.
9) Dry system pressure flow switch.
10) Fire pump running.

c. Fire-alarm signal must initiate the following actions:

1) Continuously operate alarm notification appliances.

2) Identify alarm and specific initiating device at FACU and remote annunciators.
3) Transmit alarm signal to remote alarm receiving station.
4) Unlock electric door locks in designated egress paths.
5) Release fire and smoke doors held open by magnetic door holders.
6) Activate alarm communication system.
7) Switch HVAC equipment controls to fire-alarm mode.
8) Close smoke dampers in air ducts of designated air-conditioning duct systems.
9) Recall elevators to primary or alternate recall floors.
10) Activate elevator power shunt trip.
11) Record events in system memory.
12) Record events by system printer.
13) Indicate device in alarm on graphic annunciator.

d. Supervisory signal initiation must be by one or more of the following devices and actions:

1) Valve supervisory switch.
2) High- or low-air-pressure switch of dry-pipe sprinkler system.
3) Elevator shunt-trip supervision.
4) Fire pump is running.
5) Fire pump has lost power.
6) Power to fire pump has phase reversal.

e. System trouble signal initiation must be by one or more of the following devices and actions:

1) Open circuits, shorts, and grounds in designated circuits.
2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4) Loss of primary power at FACU.
5) Ground or single break in internal circuits of FACU.
6) Abnormal ac voltage at FACU.
7) Break in standby battery circuitry.
8) Failure of battery charging.
9) Abnormal position of switch at FACU or annunciator.

f. System Printer:

1) Printer must be listed and labeled as integral part of fire-alarm system.

g. Device Guards:

1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.

a) Factory fabricated and furnished by device manufacturer.
b) Finish: Paint of color to match protected device.

h. Document Storage Box:

1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch (216-by-279 mm) manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
3) Color: Red powder-coat epoxy finish.
4) Labeling: Permanently screened with 1 inch (25 mm) high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
5) Security: Locked with 3/4 inch (19 mm) barrel lock. Provide solid 12 inch (304 mm) stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

B. Performance Criteria:

1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:

a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
b. Include real-time clock for time annotation of events on event recorder and printer.
c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
d. FACU must be listed for connection to central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.

1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.

g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.

1) Annunciator and Display: LCD, 80 characters, minimum.

h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.

1) Annunciator and Display: LCD, three line(s) of 80 characters, minimum.
2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters].

i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1) Pathway Class Designations: NFPA 72, Class A.
2) Install no more than 100 addressable devices on each signaling-line circuit.
3) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.

j. Serial Interfaces:

1) One dedicated RS 485 port for central-station operation using point ID DACT.
2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
3) One USB port for PC configuration.

k. Notification-Appliance Circuit:

1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.

l. Elevator Recall: Initiate by one of the following alarm-initiating devices:

1) Elevator lobby detectors except lobby detector on designated floor.
2) Smoke detectors in elevator machine room.
3) Smoke detectors in elevator hoistway.

m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.

n. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.

1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

o. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

p. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
q. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and digital alarm radio transmitters must be powered by 24 V(dc) source.
r. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
s. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
t. Batteries: Sealed lead calcium.

2.3 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
4. Able to perform at up to 90 percent relative humidity at 90 deg F (32 deg C) temperature.
5. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:
1. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.

b. General Characteristics:

1) Detectors must be two-wire type.
2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.

4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:

    a) Primary status.
    b) Device type.
    c) Present average value.
    d) Present sensitivity selected.
    e) Sensor range (normal, dirty, etc.).

8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
9) Color: White.
10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
11) Multiple levels of detection sensitivity for each sensor.
12) Sensitivity levels based on time of day.

2.5 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:

    a. NFPA 72.

2. General Characteristics:

    a. Detectors must be two-wire type.
    b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
    c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
    d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
    e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
    f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:

        1) Primary status.
        2) Device type.
        3) Present average value.

4) Present sensitivity selected.
5) Sensor range (normal, dirty, etc.).

g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
h. Each sensor must have multiple levels of detection sensitivity.
i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. Description: Carbon monoxide detector listed for connection to fire-alarm system.

B. Performance Criteria:

1. Regulatory Requirements:

a. NFPA 72
b. NFPA 720.
c. UL 2075.

2. General Characteristics:

a. Mounting: Adapter plate for outlet box mounting.
b. Testable by introducing test carbon monoxide into sensing cell.
c. Detector must provide alarm contacts and trouble contacts.
d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
e. Locate, mount, and wire in accordance with manufacturer's written instructions.
f. Provide means for addressable connection to fire-alarm system.
g. Test button simulates alarm condition.

2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:
1. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.
2) UL 521.

b. General Characteristics:

1) Temperature sensors must test for and communicate sensitivity range of device.

c. Actuated by fixed temperature of 135 deg F (57 deg C.

d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
g. Color: White.

2.8 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:
1. Description: Horns, bells, or other notification devices that cannot output voice messages.
2. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.

b. General Characteristics:

1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
2) Chimes, Low-Level Output: Vibrating type, 75 dB(A-weighted) minimum rated output.
3) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:
1. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.
2) UL 1971.

b. General Characteristics:

1) Rated Light Output:
a) 15/30/75/110 cd, selectable in field.

2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
3) Mounting: Wall mounted unless otherwise indicated.
4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
5) Flashing must be in temporal pattern, synchronized with other units.
6) Strobe Leads: Factory connected to screw terminals.
7) Mounting Faceplate: Factory finished, red.

2.9 FIRE-ALARM REMOTE ANNUNCIATORS

A. Performance Criteria:

1. Regulatory Requirements:

a. NFPA 72.

2. General Characteristics:

a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.

1) Mounting: Surface cabinet, NEMA 250, Type 1.

b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Performance Criteria:

1. Regulatory Requirements:

a. NFPA 72.

2. General Characteristics:

a. Include address-setting means on module.
b. Store internal identifying code for control panel use to identify module type.
c. Listed for controlling HVAC fan motor controllers.
d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and/or to circuit-breaker shunt trip for power shutdown.

1) Allow control panel to switch relay contacts on command.
2) Have minimum of two normally open and two normally closed contacts available for field wiring.

f. Control Module:

1) Operate notification devices.
2) Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

A. Performance Criteria:

1. Regulatory Requirements:

   a. NFPA 72.

2. General Characteristics:

   a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
   b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture two telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
   c. Local functions and display at DACT must include the following:

      1) Verification that both telephone lines are available.
      2) Programming device.
      3) LED display.
      4) Manual test report function and manual transmission clear indication.
      5) Communications failure with central station or FACU.

   d. Digital data transmission must include the following:

      1) Address of alarm-initiating device.
      2) Address of supervisory signal.
      3) Address of trouble-initiating device.
      4) Loss of ac supply.
      5) Loss of power.
      6) Low battery.
      7) Abnormal test signal.
      8) Communication bus failure.

   e. Secondary Power: Integral rechargeable battery and automatic charger.
   f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EQUIPMENT

A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before other trades have completed cleanup must be replaced.
2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

B. Equipment Floor and Wall Mounting: Install FACU on finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inch (1980 mm) above finished floor.

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch (1520 mm) of exit doorway.
2. Mount manual fire-alarm box on background of contrasting color.
3. Operable part of manual fire-alarm box must be between 42 and 48 inch (1060 and 1220 mm) above floor level. Devices must be mounted at same height unless otherwise indicated.

E. Smoke- and Heat-Detector Spacing:

1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing must not exceed 30 ft. (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inch (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inch (300 mm) from lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch (9100 mm) long must be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 6 inch (150 mm) below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch (150 mm) below ceiling. Install devices at same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.5 PATHWAYS

A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch (2440 mm) above floor must be installed in EMT.

B. Exposed EMT must be painted red enamel.

3.6 CONNECTIONS

A. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch (910 mm) from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
1. Electronically locked doors and access gates.
2. Alarm-initiating connection to elevator recall system and components.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
5. Supervisory connections at elevator shunt-trip breaker.
6. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
7. Supervisory connections at fire-pump engine control panel.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in location visible from FACU.

3.8 GROUNDING

A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction.

B. Administrant for Tests and Inspections:

1. Owner will engage qualified testing agency to administer and perform tests and inspections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.

2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One 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.

3.10 MAINTENANCE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

END OF SECTION 284621.11

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, concrete sidewalks, light poles and bases, and pavement markings.
3. Removing designated trees, shrubs, and other plant life.
4. Excavating and stockpiling topsoil.
5. Asphalt pavement sawcutting.

B. Related Sections:
1. Section 31 23 16 - Excavation.

1.2 REFERENCE

A. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Utility mark out subcontractor qualifications and contact information, for review and approval by the Civil Engineer.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Nassau County Department of Public Works standards.

B. Conform to section 31 25 13 Erosion Controls and the Nassau County Department of Public Works requirements for the legal disposal of debris.

C. Maintain one copy of each document on site.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify topsoil stockpile area, waste area and salvage area for placing removed materials.

D. Identify, by marking, all locations of proposed asphalt sawcuts.

3.2 PREPARATION

A. Call Dig Safely New York One Call Center at (800) 272-4480 not less than five (5) working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.
2. Inform Jericho Water District of proposed work and work schedule.

B. It is the responsibility of the contractor to engage with an approved, private underground utility location and mark out company to have all on-site underground utilities, within the work area, completely located and marked out, at his own expense.

3.3 PROTECTION

A. Locate, identify, and protect all underground and above utilities from damage, at subject site.

B. Protect bench marks, survey control points, existing pavements, vegetation, curbs and structures to remain from damage or displacement.

3.4 CLEARING

A. Remove trees as indicated in Landscape Plan and in Section 32 93 00 - Plants.

3.5 REMOVAL

A. Remove and dispose of debris, rock, and extracted plant life.

B. Remove and dispose of paving, curbs, steps, concrete sidewalks and surface debris, as indicated on Drawings.

C. Remove and dispose of abandoned utilities. Indicate removal termination point and capping locations for underground utilities on Record Documents.

D. Continuously clean-up, remove and dispose of waste materials from site. Do not allow materials to accumulate on site.

E. Do not burn or bury materials on site. Leave site in clean condition.

F. Neatly execute full depth asphalt pavement sawcuts at locations indicated in plans, protecting existing asphalt pavement to remain. Remove and dispose of asphalt pavement, within limits of pavement demolition, as indicated in plans.

3.6 TOPSOIL EXCAVATION

A. Excavate topsoil as noted on plans and stockpile without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile topsoil in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.

D. Do not remove topsoil from site.

END OF SECTION 311000

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating for paving.
2. Excavating for site, sanitary and drainage structures.

B. Related Sections:
1. Section 31 10 00 – Site Clearing.
2. Section 31 23 23 – Fill.
3. Section 32 12 16 – Asphalt Paving.
4. Section 32 13 13 – Concrete Paving.
5. Section 33 13 00 – Storm Utility Drainage Piping.
6. Excavating for Building Foundations.

1.2 REFERENCES

A. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. Local utility standards when working within 24 inches of utility lines.

C. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Nassau County Department of Public Works standards.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of New York.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Protect utilities indicated to remain from damage.

C. Protect plant life, lawns, and other natural features remaining as portion of final landscaping.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and site structures, and construction operations.

C. Slope banks with machine to angle of repose or less until shored.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Trim excavation. Remove loose matter.

G. Remove lumped subsoil, boulders, and rocks as directed by owner.

H. Notify Architect/Engineer of unexpected subsurface conditions.

I. Remove excess and unsuitable material from site.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 73 00 - Execution Requirements and 01 77 00 - Closeout Procedures.

B. Request visual inspection of bearing surfaces by Architect, Engineer or Owner.

3.4 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating utility trenches, located 5 feet outside building.

B. Related Sections:
   1. Section 33 41 00 - Storm Utility Drainage Piping.

1.2 REFERENCES

A. Civil/ Site Drawings.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Samples: Submit, in air-tight containers, 10 lb sample of each type of imported fill to testing laboratory.

D. Materials Source: Submit name of imported fill materials suppliers.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Nassau County Department of Public Works standards.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of New York.

1.7 COORDINATION

A. Section 01 31 00 - Coordination: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Bedding, backfilling below springline and backfill above springline fill Class I, II or III material, as per Unified Soil Classification System. Where pipe is installed with less than 3 feet of cover within pavement areas, all backfill material, throughout the pipe zone is to be Class I material.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
1. Architect, Engineer or Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life, lawns, and other features remaining as portion of final landscaping.

C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities indicated to remain.

E. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard, measured by volume. Remove and legally dispose of larger material off the project site.

C. Perform excavation within 24 inches of existing utilities by hand.

D. Cut trenches sufficiently wide to enable installation. Remove water or materials that interfere with Work.

E. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.

F. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

G. Do not interfere with 45 degree bearing splay of foundations.

H. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.

I. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Architect/Engineer until suitable material is encountered.

J. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Class I, II or III material and compact to density equal to or greater than requirements for subsequent backfill material.

K. Trim excavation. Remove loose matter.

L. Correct areas over excavated areas with compacted Class I, II or III material as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.

M. Remove excess subsoil not intended for reuse, from site.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Temporary sheeting conforming to Industrial Code 23 as amended to the N.Y.S. Department of Labor, Board of Standards and Appeals shall be installed where required by the Code and in accordance with Occupational Safety and Health Act requirements.

3.5 BACKFILLING

A. Backfill: as per section 31 23 23 Fill.

3.6 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 31 23 17

SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backfilling, utility trenches, and drainage and sanitary structures to subgrade elevations.
2. Fill under paving.
3. Fill for over-excavation.

B. Related Sections:
1. Section 31 23 16 - Excavation.
2. Section 32 11 23 - Aggregate Base Courses.
3. Section 32 12 16 - Asphalt Paving.
4. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2216 – Standard Test Methods for Laboratory Determination of Water (moisture) Content of Soil and Rock by Mass.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill material to testing laboratory.

C. Materials Source: Submit name of imported fill materials suppliers.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Aggregate Base Course: As specified in Section 32 11 23.

B. Sand and Gravel Backfill: As per typical drywell detail notes.

C. Collar Material: As per typical drywell detail notes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to minimum 95% of maximum density, as per ASTM D1557 modified proctor test.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subgrade.

C. Scarify subgrade surface to depth of 6 inches.

D. Proof roll subgrade to identify soft spots; fill and compact to density equal to or greater than requirements for subgrade material.

3.3 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen specified materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place material as follows:

1. Aggregate Base Courses: Maximum 8 inches per lift.
2. Sand and Gravel backfill: Maximum 12 inches per lift.

3. Collar Material: Maximum 12 inches per lift.

D. Employ placement method that does not disturb or damage other work or utilities in trenches.

E. Maintain optimum moisture content of backfill materials as per ASTM D2216 or ASTM D3017, ASTM D1557 modified proctor test to attain required compaction density.

F. Required compaction density for fill materials is minimum 95% of maximum dry density, as per ASTM D1557 modified proctor test.

G. Make gradual grade changes. Blend slope into level areas.

H. Remove surplus backfill materials from site.

I. Leave fill material stockpile areas free of excess fill materials.

J. Required compaction densities in trenches should be as per drainage pipe trench detail.

K. Do not leave more than 50 feet of trench open at end of working day.

L. Protect open trench to prevent danger to Owner, the public and other contractors.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Perform laboratory material tests in accordance with ASTM D1557 modified proctor test.

C. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017 or ASTM D2216.
3. Compaction Tests: ASTM D1557 modified proctor test.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Frequency of Tests: Minimum of 1 field density test, per 1,500 square feet per lift under pavements. Minimum of 1 moisture test per soil or aggregate type, per day of filling activities. Minimum of 1 field density test per 75 linear feet, per lift, in all utility trenches.

F. Proof roll compacted subgrade surfaces under paving.

3.6 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Protecting finished work.

END OF SECTION 312323

SECTION 31 25 13 - EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Inlet Silt Protection.
   2. Silt Fence.
   3. Erosion and sediment control devices as per the NYSDEC Standards and Specifications.

B. Related Sections:
   1. Section 312316 - Excavation.
   2. Section 312323 - Fill.

1.2 REFERENCES

A. New York State Department of Environmental Conservation Standards and Specifications for Erosion and Sediment Control.

B. New York State Department of Environmental Conservation SPDES General Permit for Stormwater Discharges from Construction Activities.

C. Erosion & Sediment Control Plans.

D. Erosion control measures for demolition work, as shown in notes on the Site Demolition Plan.

1.3 SUBMITTALS

A. Product Data: Submit data on pre-manufactured items, i.e. geotextiles, filter bags, etc.

1.4 CLOSEOUT SUBMITTALS

A. Section 017300 - Execution Requirements and Section 017700 Closeout Procedures.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with New York State Department of Environmental Conservation Standards and Specifications for Erosion and Sediment Control requirements.

1.6 PRE-INSTALLATION MEETINGS

A. Section 012020 – Progress Meetings.

1.7 COORDINATION

A. Section 013100 - Coordination.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish materials in accordance with both the New York State Department of Environmental Conservation Standards and Specifications for Erosion and Sediment Control requirements and all pertinent drawing notes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

3.2 GENERAL

A. Install all erosion and sediment control devices in accordance with the specifications and procedures indicated in the New York Department of Environmental Conservation Standards and Specifications for Erosion and Sediment Control.

3.3 FIELD QUALITY CONTROL

A. Inspect all erosion and sediment control devices: a) twice every seven (7) days; and b) within twenty-four (24) hours following any rainfall event one-half inch or greater in total rainfall amount. In accordance with the New York State Department of Environmental Conservation, these inspections are is to be completed by a qualified professional who is a person knowledgeable in the principles and practice of erosion and sediment controls, such as a New York State licensed professional engineer, Certified Professional in Erosion and Sediment Control, or a soil scientist. Maintain a copy of each inspection report on site.

B. Make all necessary repairs to ensure erosion and sediment controls are in good working order.

C. Replace any damaged erosion and sediment control devices.

D. Relocate any existing erosion and sediment control devices that interfere with the required contract work.

3.4 CLEANING

A. Section 017000 - Closeout Procedures: Requirements for cleaning.

B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

C. Do not damage structure or device during cleaning operations.

D. Do not permit sediment to erode into the surrounding undisturbed areas or onto the adjacent roadways.

3.5 PROTECTION

A. Section 017000 - Closeout Procedures: Requirements for protecting finished Work.

END OF SECTION 312513

SECTION 32 11 23 - AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aggregate base course.

B. Related Sections:
   1. Section 31 23 23 - Fill.
   2. Section 32 12 16 - Asphalt Paving.
   3. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 10 lb sample of aggregate fill material to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with New York State Department of Transportation standard.

C. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course Material: In accordance with New York State Department of Transportation item # 304-2.02.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify subgrade has been proof rolled, inspected, gradients and elevations are correct and is dry.

3.2 PREPARATION

A. Correct irregularities in subgrade gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place aggregate base course on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Place aggregate base course in maximum 6 inch lifts and vibratory roller compact to required minimum 95% of maximum dry density, as per ASTM D1557 modified proctor test.

B. Level and contour surfaces to elevations and gradients indicated.

C. Maintain optimum moisture content of aggregate base course materials to attain required minimum 95% of maximum dry density, as per ASTM D1557 modified proctor test.

D. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.

C. Maximum Variation From Thickness: 1/4 inch.

D. Maximum Variation From Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures.

B. Compaction testing will be performed in accordance with ASTM D1556, ASTM D2167, or ASTM D2922.

C. Moisture testing to be in accordance with ASTM D3017 or ASTM D2216.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Frequency of Tests: minimum of 1 density test per 1,500 square feet, per 6" lift. Minimum of 1 moisture test per day of aggregate placement activities.

3.6 SCHEDULES

A. Under Asphalt Pavement:
   1. Compact placed aggregate fill uniformly, at optimum moisture content, to achieve minimum 95 percent of maximum dry density, as determined by ASTM D1557 modified proctor test.

B. Under Concrete Pavement:
   1. Compact placed aggregate materials uniformly, at optimum moisture content, to achieve minimum 95 percent of maximum dry density, as determined by ASTM D1557 modified proctor test.

END OF SECTION 32 11 23

SECTION 32 12 16 - ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphaltic concrete paving.
2. Aggregate base course.

B. Related Sections:

1. Section 31 23 16 - Excavation.
2. Section 31 23 23 - Fill.
3. Section 32 11 23 - Aggregate Base Course.
4. Section 33 41 00 - Storm Utility Drainage Piping.
5. New York State Department of Transportation Standard Specification 687 - Thermoplastic Reflectorized Pavement Markings

1.2 REFERENCES

A. Asphalt Institute:
1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.

B. ASTM International:
1. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
2. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

C. New York State Department of Transportation:
1. Standard Specifications – Construction and materials.
2. Standard Specification Section 687 – Thermoplastic Reflectorized Pavement Markings

D. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Product Data: Submit product information and mix design.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Sample testing information as per NYSDOT standards.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with New York State Department of Transportation standards.

B. Mixing Plant: Conform to New York State Department of Transportation standards.

C. Obtain materials from same source throughout.

D. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 5 years experience in asphalt pavement construction.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course: as per section 32 11 23 Aggregate Base Courses.

B. Asphalt Concrete Course: In accordance with New York State Department of Transportation standard item # 404.098301.

C. Asphalt Concrete Binder Course: In accordance with New York State Department of Transportation standard item # 404.258901.

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

B. Submit proposed asphalt mix design of each class of asphalt mix for review prior to beginning of Work.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify compacted aggregate base course is dry and ready to support asphalt paving and imposed loads.

C. Verify gradients and elevations of aggregate base course are correct.

D. Verify curbs, gutters, drainage structure frame and grate installed in correct position and elevation.

3.2 AGGREGATE BASE COURSE

A. Aggregate Base Course: Install as specified in Section 32 11 23.

3.3 PLACING ASPHALT PAVEMENT

A. Place asphalt concrete course to 2 inch compacted thickness.

B. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

C. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

C. Scheduled Compacted Thickness: Within 1/4 inch.

D. Variation from Indicated Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Take samples and perform tests in accordance with New York State Department of Transportation standards.

3.6 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Protecting finished work.

B. Plant inspection in accordance with New York State Department of Transportation item #404.000011.

C. Immediately after placement, protect pavement from mechanical injury for 48 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete sidewalks.
2. Concrete landings at buildings.
3. Concrete curbs.

B. Related Sections:
1. Section 31 23 16 – Excavation.
2. Section 31 23 23 - Fill.
3. Section 32 11 23 - Aggregate Base Courses.
4. Section 32 12 16 - Asphalt Paving.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

B. ASTM International:
1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
2. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
3. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
4. ASTM A884 – Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
5. ASTM C33 - Standard Specification for Concrete Aggregates.
6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
9. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
10. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
11. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
12. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
13. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Product Data: Submit data on joint filler admixtures and curing compounds. Concrete mix design as per ASTM C94/C94M, Option C.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with Nassau County Department of Public Works standard.

C. Maintain one copy of each document on site.

D. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this nature and scale.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 20 20 – Progress Meetings: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: Conform to ACI 301.

2.2 REINFORCEMENT

A. Reinforcing Steel: ASTM A775; Grade 60.

B. Welded Steel Wire Fabric: Plain type, ASTM A1064 in flat sheets; epoxy coated.

C. Dowels: ASTM A775/A775M; 60 ksi yield grade, plain steel, epoxy coated.

D. Steel Reinforcing Bars, ASTM A615, Grade 60, deformed.

2.3 CONCRETE MATERIALS

A. Concrete Materials: in accordance with Nassau County Department of Public Works standards.

B. Cement: in accordance with Nassau County Department of Public Works standards.

C. Fine and Coarse Mix Aggregates: ASTM C33.

D. Water: Potable, not detrimental to concrete.

E. Air Entrainment: ASTM C260.

2.4 CONCRETE MIX - BY PERFORMANCE CRITERIA

A. Mix and deliver concrete in accordance with ASTM C94/C94M, Option C.

B. Provide concrete to the following criteria:
   1. Compressive Strength: 4,000 psi at 28 days.
   2. Slump: 4 inches maximum.
   3. Maximum Water/Cement Ratio: 0.45.
   4. Air Entrainment: 4 to 6 percent.

C. Use accelerating admixtures in cold weather only when requested by the contractor in writing and when approved by the Architect/Engineer in writing. Use of admixtures will not relax cold weather placement requirements.

D. Use calcium chloride only when requested by the contractor in writing and when approved by the Architect/Engineer in writing.

E. Use set retarding admixtures during hot weather only when requested by the contractor in writing and when approved by the Architect/Engineer in writing.

2.5 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services: Provide mix design for each class of concrete mix to be incorporated in the work.

B. Submit proposed mix design of each class of concrete to Architect/ Engineer for review, prior to commencement of Work.

C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

D. Test samples in accordance with ACI 301.

E. Furnish all test results to Architect/ Engineer for review.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify compacted subgrade and aggregate base course materials are acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

3.2 SUBBASE

A. Aggregate Base Course: Install as specified in Section 32 11 23.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

A. Place reinforcement as indicated.

B. Interrupt reinforcement at expansion joints.

C. Place dowels or reinforcement to achieve pavement and curb alignment as detailed.

3.6 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Ensure reinforcement, inserts, embedded parts, formed joints and are not disturbed during concrete placement.

C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

A. Place expansion joints at 20-foot intervals. Align curb, gutter, and sidewalk joints.

B. Place joint filler between paving components and building or other appurtenances.

C. Provide scored or sawn joints at 4 feet intervals between sidewalks.

D. Provide keyed joints as indicated.

3.8 FINISHING

A. Curbs and Sidewalks: Light broom.

B. Direction of Texturing: Parallel to pavement direction for curbs. Perpendicular to travel direction for sidewalks and landings

C. Place curing compound on exposed concrete surfaces immediately after finishing.

3.9 JOINT SEALING

A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

C. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures.

B. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.

C. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken.

E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION 321313

SECTION 323111 - GATE OPERATORS

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 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the gate operator as shown on the drawings and/or specified herein.

1.3 REFERENCES

A. American Society Testing Materials (ASTM): ASTM F2200 – Standard Specification for Automated Vehicular Gate Construction.

B. National Electrical Manufacturers Association (NEMA): NEMA ICS 6.

C. Underwriters Laboratories (UL): UL 325 – Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

D. Underwriters Laboratories (UL): UL 991 – Standard for Tests for Safety Related Controls Employing Solid-State Devices.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installation performed by factory-authorized dealer contractor specifically trained in gate operator systems of the type found within this section.

1. Provide documentation of maintenance and repair service availability for emergency conditions.

2. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.5 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements.

3. Installation methods.

B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge connections, and accessories.

1. Operation, installation, and maintenance manuals including wire diagrams.

2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.

B. Store products indoors in manufacturer's original containers and packaging with labels clearly identifying product name and manufacturer. Protect from damage.

1.7 WARRANTY

A. Manufacturer's standard two (2) year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: LiftMaster; 845 Larch Avenue; Elmhurst, IL 60126-1196. ASD. Toll-Free: 800.282.6225. Email: specs@LiftMaster.com Web: www.LiftMaster.com

2.2 GATE OPERATORS

A. Heavy-Duty Industrial Barrier Gate Operator: Model BG770, as manufactured by LiftMaster, or approved equal.

1. NOTE: To be compliant with UL 325 and industry safety guidelines, qualified secondary entrapment devices such as photo eyes or sensing edges are required to be installed with this gate operator – see Parking Control Equipment, elsewhere in Division 11.

2. Compliance: ETL Listed. Compliant to the UL 325, UL 991 and CSA C22.2 No. 247 standards.

3. Operator Speed: 90-degrees in 4 seconds.

4. Gate Arms: Provide 15-foot aluminum arms, square, yellow and black stripes.

5. Electrical Power Requirements: 208V AC, 3 - phase, 60 Hz.

6. Accessory Electrical Power Requirements: Not applicable.

7. Gear Reduction: 60:1 worm gear reduction in oil bath.

8. Motor: 1/2 HP, continuous duty.

9. Metal Frame: 11-gauge pre-galvanized steel.

10. Enclosure: Powder-coated weather-resistant steel enclosure.

11. Configuration: Standard.

12. Control Inputs: Control inputs allow the connection of optional external devices like loop detectors, photo eyes, telephone entry systems, access control systems and radio receivers.

13. Limit Settings: Driven limit cams are fully adjustable.

14. Accessories: Provide the optional accessories listed below.

    a. Timer-to-Close: Programmable module can be set from 1 to 1,024 seconds. The unit will automatically close when programmed time has expired.
    b. Plug-in Style Loop Detectors: Operator incorporates 2-harness support system that can accept up to 2 plug-in loop detectors for exit or hold-open functions.
    c. Thermostatically Controlled Heater: For use in extreme cold environments.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where gate operator is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION GENERAL

A. Unit shall be mounted, firmly secured, plumb and level, as required.

B. Wiring shall be uniform and in accordance with national electric codes and manufacturer's instructions.

C. All splices shall be in easily accessible junction boxes or on terminal boards.

D. All cable runs in all junction boxes shall be tagged and identified.

E. Coordinate all work with other effected trades and contractors.

3.3 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.

B. System shall function as specified.

3.4 SYSTEM TEST PROCEDURES

A. System shall be completely tested to assure that all components and accessories are hooked-up and in working order.

B. System shall be pre-tested by contractor and certified to function in accordance with plans and specifications.

C. System shall be tested in presence of Owner's representative.

3.5 OWNER INSTRUCTIONS

A. Installation contractor shall conduct up to (1) hour of instruction in use and operation of the system to designated Owner representatives, within (30) days of acceptance.

B. Installation Contractor shall conduct up to (1) hour of technical training, in troubleshooting and service of the system, to designated owner representatives within (90) days of system acceptance.

3.6 MANUALS AND DRAWINGS

A. Contractor shall provide owner with (2) copies of standard factory prepared operation, installation and maintenance manuals. Manuals shall include typical wiring diagrams.

B. Contractor shall provide owner with (2) copies of any risers, layouts, and special wiring diagrams showing any changes to standard drawings, if required on project.

3.7 MAINTENANCE

A. The manufacturer recommends periodic maintenance at three-month intervals as described in the installation and maintenance manual.

B. External reversing devices should be checked at least once a month.

END OF SECTION

SECTION 328400 – EXTERIOR IRRIGATION ON GRADE (PERFORMANCE)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Under this Item, the Contractor shall design, furnish and install an exterior irrigation on grade to conform to existing and proposed grades at the locations indicated in the plans, specifications, work orders, sketches and/or as directed by the County's representative.

1.02 DESCRIPTION OF WORK

A. Supply all labor material tools and equipment necessary to furnish and install the Exterior Irrigation System which includes all related plumbing and electrical work. Such Work shall include but is not necessarily limited to the following:

1. Testing at site to verify static and working pressure available for irrigation.
2. System design layout
3. Provide layout drawings and description of operation.
4. Construction details.
5. Excavation and backfill of trenches and pits in the planters.
6. Wiring, Piping and Valves from the main feed line to the control unit and from the control unit to the existing water and electrical source.
7. Controllers.
8. Drip hoses and Emitters.
9. Electrical and plumbing connection to source.
10. Lines to each planter location.
11. Rain shutoff.
12. Proper backflow protection devices and filters according to local codes, ordinances.
13. As-built drawings.
14 Testing, adjustment and guarantee.
15. Shop drawings.

B. This section requires the Contractor to supply material certification and related data as required or specified herein.

C. Contractor shall comply with all applicable codes and regulations regarding material, installations.

D. The materials method of manufacture and installation procedures as itemized in this section are intended as a guide specification to obtain acceptable standards.

E. The irrigation work is to be provided by performance requirement only. The area to be automatically irrigated is as shown on the Shop Drawings and Plans. Performance requirement will be standard coverage for planting areas, with double coverage for all areas. The drip lines shall be laid out to accomplish the foregoing without causing adjacent walking and wall surfaces to become wet.

F. The irrigation system is to be placed in all planting beds, unless directed otherwise. The Contractor is responsible for all aspects of the irrigation system from the water source to the drippers, excluding the main feed line. All plumbing and electrical connections to the main feed line from the control unit to the existing water and electrical source shall be installed by the irrigation contractor and coordinated with the project plumber and electrician. Contractors shall become aware of the limitations placed upon the installation of the irrigation system.

G. The contractor shall locate all necessary controls at the source of existing water and electrical service. If alternate control locations not having existing service are selected, the contractor shall be responsible for all additional plumbing, electrical, and related work necessary in providing service to those locations.

1.03 SUBMITTALS

A. Submit all of following to the Owner and Owner's Representative for approval.

1. Provide a system design layout drawings 1/8”=1-0’ scale or larger of the site plan, indicating piping (both above and below the structural slab), drippers, valves and controls, design, pressure, and all sizing of mains and laterals.

2. Provide catalogue cuts and manufacturer’s literature for all components.

3. Provide the Owner with manual of operations for system.

4. After completion of the piping installation, the Contractor shall furnish an “as Built” drawing showing all drippers, valves, pipelines to scale with dimensions where required, final pipeline layout. A minimum of two dimensions from building corners shall be used to indicate all valve and quick coupler locations. Instruction sheets and part lists covering all operating equipment will be bound into a folder and furnished to the Landscape Architect in duplicate. The As-Built Drawing shall be completed by the contractor and provided to the Owner’s and the Owner’s Representative prior to inspecting the system for final acceptance.

1.05 COORDINATION EXAMINATION AND VERIFICATION:

A. Contractor must coordinate all work with the project plumbing and electrical contractor.

B. Study the specifications and provide all layout drawings and descriptions necessary to ensure completeness of the work required under this section.

C. All work under this section shall be coordinated with the affected trades

D. During the bidding period, verify all conditions at the site on which the work of the contract is dependent.

PART 2 - PRODUCT

2.01 MATERIALS

A. Pipes and Pipe Fittings:

1. Main Line and Lateral Pipe – Provide Schedule 40 Polyvinyl chloride pipe (hereinafter referred to as PVC pipe) complying with ASTM D 1785 for Schedule 40 pipe and ASTM D1784 for PVC compounds in 20-foot lengths, free of holes, foreign material, blister, wrinkles or dents.

2. PVC Fittings – Schedule 40 PVC socket fitting, Type 1, Cell Classification 12454-B, complying with ASTM D2466, D2467 and D1784. All pipe fittings shall be of the same material as the pipe specified and shall be compatible with the pipe furnished.

3. Threaded Nipples – Schedule 80 PVC Pipe.

4. Risers– Schedule 40 galvanized steel pipe, unless otherwise indicated.

5. Cleaner, Primer and Solvent Cements
   a. Cleaner: Uni-Weld 7300 cleaner or approved substitute
   b. Primer: Uni-Weld 8700 hi-Etch purple primer, ASTM F656, or an approved substitute.
   c. Solvent Cements: Uni-Weld 2200 clear, light viscosity type, for lateral lines, Uni-Weld 1700 gray, heavy duty viscosity type, for lateral lines larger than 2 ½" diameter, and Uni-Weld 6700 for clear, light viscosity type for FlexPVC connection or approved equal.

6. Sealing Tapes and Pastes:
   a. Threaded Connections between PVC and Metal Pipe: Rectorseal NO. 100 virgin heavy duty sealing paste, Plastojoint Stick as manufactured by Lake Chemical Company, or Teflon tape.
   b. Metal to Metal Connection: Rectorseal No. 5 slow dry, soft set pipe thread compound.
   c. PVC to PVC Connections: Teflon tape.
   d. Plastic Irrigation Head or Plastic Valve to Pipe Connections: Teflon tape.

7. Pipe Lubricant: As provided by pipe manufacturer for "O" ring gasket and pipe spigot ends. If not provided, use I.P.S. Weld-On No. 787 gasket lubricant as manufactured by Industrial Polychemical Service, or approved equal.

8. Flexible Nipples: COBRA CONNECTOR, U.S. Patent Nos. 5,039,011 & 5,221,114, with ½ inch Nominal I.P.S. heavy wall flexible hose, as manufactured by F.P. Parker Manufacturing Co. Inc.,(702) 358-7900 or (510) 657-1641, or approved equal. Material is available from Neumark Inc., Albuquerque, NM, or approved equal.

9. Sleeves: See Civil Engineering documents for information.

B. Valve Boxes: Provide and install standard green colored valve box with cover as Manufactured by Carson, or approved equal. Valve boxes shall be sized to allow room for testing, manual operation, calibration, removal, and maintenance of equipment.

C. Automatic Zone Valves

1. Provide valves with a manual bleed screw on the bonnet and bleed ports protected with built-in filter. Provide valve which may be installed at any angle and has a flow control and manual shutoff.

2. Material: Noncorrosive.

3. Operation: Open and close smoothly with low pressure loss.

4. Solenoid: 24 volts A.C. 60 Hz, energy consumption not exceeding 6 watts.

5. Identification: Clearly tag with legible permanent brass waterproof label indicating the controller zone number.

D. Manual Valves: Brass angle valves with brass cross handles.

E. Controllers: Provide and install Mini-Clik Freeze Sensor, Model 401 as manufactured by Glen-Hilton Products Inc., (804) 264-0055, or approved equal.

1. All controllers shall be electric automatic; shall be sufficient to operate the system, and as recommended by the manufacturer. Controls shall have the capacity to operate the number of stations required by the system.

2. All wiring for controllers shall comply with all applicable codes and regulations.

F. Wire:

1. Wire from the automatic control to the valves shall be supplied to enable sound operation of the system. All wiring shall be in accordance with the manufacturer's requirements, the NEC, and all the applicable codes and regulations.

2. UL approved for direct burial, type UF, rated 600 volts, PVC insulated.

3. Minimum Wire Size: No. 16 AWG.

4. Common Wire: Plastic coated, white color.

5. Control Wire: Insulated, single-strand copper designed for 24 to 50 volts, plastic 5oated, red color or copper strand meeting or exceeding ASTM B3.

G. Wire Splicing Materials: Provide watertight splices using Spears #300 connectors and #100 glue, 3M brand, DBY connectors, or approved equal.

H. Provide and install tap and backflow preventer in accordance with the requirements of the local water authority having jurisdiction.

1. Backflow preventer devices, double check assemblies, pressure regulators, filters, drip lines & emitters with root guards, master valves, electric valves, valve caps, valve key and key heads, riser, hose bibs, etc., should any or all be required. Available manufacturers offering products that may be incorporated into Works include the following:
   a. Netafim USA
   b. Rain Bird Corporation
   c. Toro Company (The); Irrigation Division
   d. or approved equal

   Supply manufacturer's data for all components of the irrigation system.

I. Pop-Up Spray Heads: Provide Rain Sprinkler Mfg. Corp., Toro Company, or approved substitute. Fixed patter, with screw-type flow adjustment, stainless steel retraction spring, and PRS module, if required. Include a serviceable screen on the spray heads to prevent foreign materials from entering the sprinkler. Set flow adjustment to ensure even coverage and to avoid overspray.

J. Automatic Drain Valves: Provide King Technology, Inc. automatic drain valve or approved substitute. Corrosion-resistant PVC plastic, with ½ inch male pipe threaded connections. The valve shall open when pressure in the line decreases to 9 psi and seal again when pressure increases to 10 psi. Provide a screen on both inlet and outlet. install automatic valves only on laterals of average pipe size 1 ½ inches or less. Install at low points and at 100 feet on center in the laterals.

K. Testing:

1. The Irrigation System shall be tested under normal water pressure and proven tight. If leaks occur, the joint or joints shall be replaced and test repeated.

H. Electrical and Plumbing Connections: Electrical and plumbing connections shall be made by this Contractor, coordinating with the project plumbing and electrical contractor, in strict conformance with all codes.

I. Soil Moisture Sensor: Provide automatic moisture sensor (adjustable from one to 7 days) to shutoff water flow during rain for each Irrigation System. Moisture sensor shall have minimum 35% water saving coefficient. Provide separate meter pits for each Irrigation System.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Where possible, all irrigation piping and conduits shall run along existing utility pipe chase. Contractor shall use extreme caution and keep wall and slab penetrations for irrigation equipment and materials to a minimum. Prior to beginning the work, submit a detailed layout drawing for review and approval by the Project Engineer. The drawing shall indicate water design pressure, pipe layout and size both above and below the structural slab, slab penetration and methods of sealing waterproofing, dripper types and location, coverage patterns, valve sizes and location, ground hydrant, and controls. Drawings shall also indicate phase and sequence of operation.

2. Before installation is started, place a stake where each dripper and ground hydrant is to be located and in accordance with the Contractor's layout drawing. The staking shall be approved by the Landcape Architect before installation is started.

3. Excavation: Excavation for the drip irrigation system shall be sufficient for the proper installation of the pipe, valves and drip lines.

4. All rubble and deleterious matter shall be removed from the trenches. Pipe shall have a firm, uniform bearing for the entire length of pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. The Contractor shall not lay PVC pipe when there is water in the trench, or lay pipe when temperature is 32 degrees F, or below.

5. All foreign matter or dirt shall be removed from inside the pipe before welding the pipe and the piping shall be kept clean by approved means during and after laying the pipe.

6. Ample precautions shall be taken to prevent damage to all plant materials, planters, and structural slab. All piping shall be routed around trees and shrubs in such a manner as to avoid damage to planting. In the case of newly planted trees, no digging shall be done within the ball of the tree.

7. Exercise care in handling, locating, unloading, and storing pipe. Any section of pipe that has been dented or damaged will be discarded unless said section of pipe is cut out and replaced with a coupling.

8. Use only the solvent supplied and recommended by the manufacturer to make the solvent welded joints, in the manner prescribed by the manufacturer.

9. Mainline and lateral pipes shall be non-visible, covered, and protected.

10. Dripline shall be installed by hand. For at grade installation, any portion of dripline shall not be visible through the mulch. For below grade installation, dripline shall have root guard and installed at an average depth of 6 inches,

minimum depth 4", and maximum depth of 8 inches. Dripline shall be installed 4 inches from all edges, curbs, and walls. Dripline spacing shall be as recommended by the supplier for each specific lawn/plant/tree type.

11. Drip Emitters: Emitters shall be installed in proper relationship to final grades.

12. Backfilling: Because of the expansion and contraction of pipe, backfilling should occur during the cool part of the day. Selected fill dirt or sand shall be used. All backfill shall be carefully placed and compacted to prevent settling.

13. All tests shall be completed prior to backfilling. However, sufficient backfill material may be placed in trenches between fittings to insure the stability of the line under pressure. In all cases, fittings and couplings must be open to visual inspection for the full period of the test.

B. Final Adjustments

1. After installation has been completed, final adjustment shall be made of the sprinkler system preparatory to the final inspection by the Landscape Architect.

2. The system shall be completely flushed to remove all debris from the lines by removing the nozzle from all heads on ends of lines and turning on the system.

3. All drippers shall be checked for proper operation, alignments, and the direction and coverage of mist and drip nozzles.

4. Prevailing wind conditions may indicate misting and/or drip coverage should be other than as shown on the plan. In this case nozzles shall be changed to provide correct coverage at the Contractor's expense.

5. Prior to final acceptance, the entire irrigation system shall be adequately tested and adjusted to ensure complete operation sequences, and that all planter and structural slab penetrations related to the irrigation system are watertight.

. C. Protection

Contractor shall be responsible for work until finally inspected tested and accepted. After delivery and before installation, the Contractor must protect work against theft, injury or damage. He shall carefully store material received on site which is not immediately installed. He shall close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

D. Cooperation and Clean Up

1. Cooperate fully with the other Contractors on the job site and leave the site in a clean and safe condition.

2. Upon completion of the job, the Contractors shall immediately remove all his tools, equipment and any surplus materials and all debris caused by his portion of the work.

E. Warranty and Guarantee

1. The Contractor shall be held strictly responsible for all parts of the work including related plumbing. All materials are fully guaranteed for one year to be without defect, of standard quality or better and the installed system is guaranteed for one year from date of acceptance to give uniform distribution and even coverage of moisture, provided the water pressure does not drop below the design pressure of the system.

2. Provide all necessary equipment and perform all work required for testing pipe leakage. All leakage tests shall be made under the supervision of the Project Engineers, who shall be notified two (2) days prior to time of testing.

3. If failure in the irrigation system or appurtenances (including watertight seals of planter and structural slab penetrations) develop within one year from the date of final acceptance of the work, the Contractor shall be required to replace or repair all faulty materials at his/her expense. The Contractor is advised to purchase material under a warranty from the manufacturer, guaranteeing proper service conditions which are established by the contract drawings, specifications, and local conditions.

4. Labor and material to fulfill the requirements of this guarantee, shall be furnished by the Contractor at no additional cost to the Owner.

5. Maintenance of the system, i.e., raising and lowering of heads to compensate for growth, cleaning, and adjustment of head, shall be given the purchaser of this system at no charge for one year, from the completion of the installation as part of the Contract.

6. Provide Owner with manual outlining operation and periodic maintenance for the system

END OF SECTION 328400

SECTION 329300 – PLANTING ON GRADE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.

B. Related Sections:
1. Section 328400 – Exterior Irrigation On Grade (Performance).

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Area: Areas to be planted.

G. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

H. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

I. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

J. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

K. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Proprietary Root-Ball-Stabilization Device: One unit.
3. Edging Materials and Accessories: Manufacturer's standard size, black finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: Five years' experience in landscape installation.
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Owner/owner representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. They may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Owner of sources of planting materials seven days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Apply antidesiccant to bamboos using power spray to provide an adequate film over culms, and foliage to protect during digging, handling, and transportation.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

G. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1.	Spring Planting:	Deciduous Trees and Shrubs	March 1 – May 1
		Deciduous Groundcovers	March 1 – May 15
		Evergreen Trees and Shrubs	April 1 – May 15
		Evergreen Groundcovers	April 1 – May 15
2.	Fall Planting:	Deciduous Trees and Shrubs	Oct. 15 – Dec. 1
		Deciduous Groundcovers	Oct. 15 – Dec. 15
		Evergreen Trees and Shrubs	Sept. 1 – Oct. 1
		Evergreen Groundcovers	Sept. 1 – Oct. 15

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty performance of tree stabilization and edgings.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

   2. Warranty Periods: From date of planting completion.

a. Trees, Shrubs, and Ornamental Grasses: 24 months.
b. Ground Covers, Perennials, and Other Plants: 24 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Owner, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded Pine bark.
2. Size Range: 3 inches maximum, 1 inch minimum.
3. Color: Dark Brown.

2.4 TREE-STABILIZATION MATERIALS

A. Root-Ball Stabilization Materials:
1. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

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) Platipus Anchors, Inc; Tree Anchoring System.
2) Foresight Products, LLC; Duckbill Rootball Fixing System.
3) Or approved equal.

2.5 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.

C. Before planting, obtain Owner's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not

further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Owner if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Owner if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.5 TREE, SHRUB, AND BAMBOO PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball flush with adjacent finish grades.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Place planting soil around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Organic Mulching: Apply organic mulch in planted areas and at tree pits as indicated.

C. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
1. Carefully remove root ball from container without damaging root ball or plant.
2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
3. approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Two per plant.

4. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees, and shrubs according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Owner, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

B. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.

a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Predrill holes if necessary to prevent splitting wood.
c. Install second set of stakes on other side of root trunk for larger trees.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and bamboos as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible, to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Owner.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations that Owner determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.

2. Species of Replacement Trees: Same species being replaced.

3.13 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of planting completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Six months from date of planting completion.

END OF SECTION 329300

SECTION 33 11 03 - COPPER TUBING AND FITTINGS (BURIED) (A & B)

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 00 – Earthwork.

B. Section 33 12 16 – Water Utility Distribution Valves.

C. Section 33 13 00 – Disinfection of Water Utility Distribution.

PART 2 PRODUCTS

2.1 MATERIAL

A. Tubing: ASTM B 88, Type K soft temper unless otherwise noted on the drawings.

B. Fittings: Cast Bronze, Flared Type; ANSI/ASME B16.26.

PART 3 EXECUTION

3.1 INSTALLATION

A. Laying Tubing:
   1. Minimum Depth: 4-foot (unless otherwise indicated on drawings) measured from finish or existing grade, whichever is lower.
   2. Install valves and fittings where indicated. Lay tubing on a continuous slope to a high point where air can be released.

B. Flaring and Assembling Tubing:
   1. Cut tube ends square.
   2. Remove all burrs and metal chips.
   3. Slip coupling nut on tubing.
   4. Flare tubing ends, use impact or mechanical type flaring tools in accordance with manufacturers' recommendations.
   5. Assemble tubing fittings and tighten coupling nuts with two wrenches, one on the nut and one on the fitting.

C. Protecting Tubing: Securely close all open ends of tubing and fittings with removable plugs whenever directed by the Owner's Representative.

D. Testing:
   1. Before the tubing, valves or other appurtenances are covered, test to 150 pounds hydrostatic pressure. Protect tubing from movement during test.
   2. Remove all defective tubing, valves, and fittings. Replace with sound items and make all leaky joints tight. Repeat the test after the repairs are made until no leaks develop when the line is subjected to the required pressure for a period of 30 minutes.
   3. All tests shall be made in such manner as the Owner's Representative shall direct and in his presence.

E. Disinfection: After completion of the hydrostatic test, disinfect all piping and fittings in accordance with Section 33 13 00.

END OF SECTION 33 11 03

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES (A & B)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Valves.

B. Related Sections:
   1. Section 03 30 00 – Cast-In-Place Concrete.
   2. Section 33 11 01 – Ductile Iron Water Pipe and Fittings.
   3. Section 33 13 00 – Disinfection of Water Utility Distribution.

1.02 REFERENCES

A. American Water Works Association:
   1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
   2. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
   3. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.
   4. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

B. National Sanitation Foundation:
   1. NSF 61 - Drinking Water System Components - Health Effects

1.03 SUBMITTALS

A. Shop Drawing:
   1. Installation Plan: Submit description of proposed installation.

B. Design Data: Submit manufacturer's latest published literature include illustrations, installation instructions, maintenance instructions and parts lists.

C. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

1.04 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Provide Operation and Maintenance Data for valves.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with State of New York Public Work's standard.

B. Maintain one (1) copy of each document on site.

1.06 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience and approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. As discussed in pre-construction meeting.

1.08 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve and ends to prevent entry of foreign matter into product body.

B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.10 MAINTENANCE MATERIALS

A. Furnish one (1) tee wrench to Owner; required length.

PART 2 PRODUCTS

2.01 CHECK VALVE

A. This valve is a hydraulically operated No-Slam Check Valve with dual speed controls.

B. The valve opens when the pressure at the inlet exceeds the discharge pressure. A gradual rate of opening prevents sudden opening surges.

C. When a pressure reversal occurs, the higher downstream pressure is applied to the cover chamber through the control tube lines, and the valve closes drip tight.

D. The valve shall carry a standard factory warranty of no less than three (3) years from shipment date. The Check Valve shall be Model Number 81-02 as manufactured by Cla-Val Company or approved equal.

2.02 AIR RELEASE VALVES

A. The air release valves for use in water or force mains shall be installed as shown on the Drawings. The valves shall have a cast iron body cover and baffle, stainless steel float, bronze water diffuser, Buna-N or Viton seat, and stainless steel trim. The fittings shall be threaded. The air release valves shall be Model 200A or 400A as manufactured by APCO Valve and Primer Corporation or approved equal.

2.03 FLANGE ADAPTER COUPLINGS

A. Flange adapter couplings shall be of the size and pressure rating required for each installation and shall be suitable for use on either cast iron or ductile iron pipe. They shall be similar or approved equal to Dresser Company, Style 128. All couplings shall have a sufficient number of factory installed anchor studs to meet or exceed a minimum test pressure rating of 230 psi minimum.

2.04 FLEXIBLE COUPLINGS

A. Flexible couplings shall be either the split type or the sleeve type as shown on the Drawings.
   1. Split type coupling shall be used with all interior and exterior piping noted on the Drawings. The couplings shall be mechanical type for radius groove piping. The couplings shall mechanically engage and lock grooved pipe ends in a positive couple and allow for angular deflection and contracting and expansion.
   2. Couplings shall consist of malleable iron, ASTM Specification A47, Grade 32510 housing clamps in two or more parts, a single chlorinated butyl composition sealing gasket with a "C" shaped cross-section and internal sealing lips projecting diagonally inward, and two or more oval track head type bolts with hexagonal heavy nuts conforming to ASTM Specification A183 and A194 to assemble the housing clamps. Bolts and nuts shall be hot dipped galvanized after fabrication.
   3. Victaulic type couplings and fittings may be used in lieu of flanged joints. Pipes shall be radius grooved as specified for use with the Victaulic couplings. Flanged adapter connections at fittings, valves, and equipment shall be Victaulic Vic Flange Style 741, equal by Gustin-Bacon Group, Division of Certain-Teed Products or approved equal.
   4. Sleeve type couplings shall be used with all buried piping. The couplings shall be of steel and shall be Dresser Style 38 or 40, as shown on the Drawings, or equal. The coupling shall be provided with hot dipped galvanized steel bolts and nuts unless indicated otherwise.
   5. All couplings shall be furnished with the pipe stop removed.

6. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
7. If the Contractor decides to use Victaulic couplings in lieu of flanged joints, he shall be responsible for supplying supports for the joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations of existing work prior to excavation and installation of valves.

3.02 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
1. Notify Engineer not less than seven days in advance of proposed utility interruption.
2. Do not proceed without written permission from the Engineer.

3.03 INSTALLATION

A. Install valves in conjunction with pipe laying; set valves plumb.

B. Install Work in accordance with State of New York Public Work's standards.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.05 FIELD QUALITY CONTROL

A. Perform pressure test on domestic site water distribution system in accordance with AWWA C600.
1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct, in presence of Architect/Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
2. Provide equipment required to perform leakage and hydrostatic pressure tests.
3. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.
4. Conduct hydrostatic test for at least two-hour duration.

5. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, apply test pressure. At conclusion of tests, close resulting piping openings.
6. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
7. Examine exposed piping, fittings, valves and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves or joints discovered, following pressure test.
8. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:
L = testing allowance, in gallons per hour
S = Length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

9. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION 33 12 16

SECTION 33 13 00 - DISINFECTION OF WATER UTILITY DISTRIBUTION (A & B)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Disinfection of water lines, water treatment equipment, storage tanks, bacteriological testing, and flushing of lines at completion of treatment.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. AWWA C651 – Standard for Disinfecting Water Mains
   2. AWWA C653 – Standard for Disinfecting Water Treatment Plants
   3. AWWA C654 – Standard for Disinfecting Wells

B. American Public Health Association/American Waterworks Association/Water Environment Federation (APHA/AWWA/WEF):
   1. Standard Methods for Examination of Water and Wastewater.

1.03 SUBMITTALS

A. Submit Disinfection Test Plan Which Details Procedure to be Utilized to Disinfect Including:
   1. Method and locations of disinfectant application.
   2. Locations of sampling points.
   3. Method of flushing and location of flushing ports.
   4. Method of dechlorination.
   5. Disposal location for dechlorinated water.

B. Submit Disinfection Reports and Include the Following:
   1. Date issued.
   2. Project name and location.
   3. Treatment subcontractor's name, address, and phone number.
   4. Type and form of disinfectant used.
   5. Time and date of disinfectant injection start.
   6. Time and date of disinfectant injection completion.
   7. Test locations.
   8. Initial and 24 hour disinfectant residuals in parts per million for each outlet tested.
   9. Time and date of flushing start.
   10. Time and date of flushing completion.
   11. Disinfectant residual after flushing in parts per million for each outlet tested.

C. Submit Bacteriological Reports and Include the Following:
   1. Date issued.

2. Project name and location.
3. Laboratory's name, certification number, address, and phone number.
4. Time and date of water sample collection.
5. Name of person collecting samples.
6. Test locations.
7. Time and date of laboratory test start.
8. Coliform bacteria test results for each outlet tested.
9. Certification that water conforms or fails to conform to bacterial standards of Federal Safe Drinking Water Act.
10. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

D. Disinfection Procedure: Submit procedure description including type of disinfectant to and calculations indicating quantities of disinfectants required to produce specified chlorine concentration in accordance with Section 3 and 4 of AWWA C653.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651 for Water Lines, C653 for Treatment Equipment, and AWWA C654 for Wells.

B. Bacteriological Laboratory: Certified by New York State.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for work conducted in hazardous atmosphere.

B. Neutralize disinfectant solution before disposal.

C. Legally dispose of disinfection solution off Project site.

D. Repair damage caused by disinfectant solution and disinfection procedures

PART 2 PRODUCTS

2.01 MATERIALS

A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form.

PART 3 EXECUTION

3.01 REGULATORY COORDINATION

A. Coordinate all bacteriological testing with the Nassau County Department of Health.

3.02 EXAMINATION OF STORAGE TANK

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Conduct inspection of tank interior before beginning disinfection.
   1. Verify tank is clean and free of polluting materials.
   2. Verify tank pipe and vent connections are properly made and clear of obstructions.
   3. Verify paint is thoroughly cured in accordance with paint manufacturer's instructions.

3.03 PREPARATION

A. Protect aquatic life and vegetation from damage from disinfectant solution purged.

3.04 APPLICATION

A. Disinfection of the piping shall be in accordance with AWWA C651.

B. Disinfection of the treatment equipment shall be in accordance with AWWA C653.

C. Disinfection of the wells shall be in accordance with AWWA C654.

D. Sampling shall be performed in accordance to the latest Nassau County Department of Health Water Quality Monitoring Requirements for Nassau County Public Water Supply.

3.05 CLEANING WATER LINES

A. Prior to chlorination, remove by flushing or other means, soil, and debris from the water lines.

3.06 INSPECTION

A. Verify that water line system is completed and cleaned.

B. Start disinfection of water lines when conditions are satisfactory.

3.07 SYSTEM TREATMENT

A. Perform disinfection of water lines in accordance with AWWA C651 and as specified in this Section.

B. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

C. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
   1. Ends of piping runs.
   2. Remote outlets.
   3. Tanks.
   4. At least two (2) outlets on each building floor where directed.

D. Maintain disinfectant in system for 24 hours.

E. When disinfectant residual is less than 25 parts per million after 24 hours, repeat system treatment.

3.08 FLUSHING

A. Remove disinfectant from water lines.

B. Flush water lines with potable water containing no more disinfectant residual than the active distribution system or 1.0 parts per million, whichever is greater.

C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.09 DISPOSAL OF CHLORINATED WATER

A. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.

3.10 WATER QUALITY TESTING

A. Bacteriological Testing for Piping
   1. Instruct bacteriological laboratory to take water samples no sooner than 24 hours after flushing system.
   2. Two (2) consecutive sets of bacteriological samples, taken 24 hours apart, must be collected from every 1,200 feet of the new main, the end of a line and from each branch Samples should be collected after final flushing and when the chlorine concentration in the water leaving the main is no higher than the generally prevailing

distribution system. Chlorine must be field measured and recorded in the Laboratory reports

3. A minimum of 24 hours after flushing system and within 24 hours before the water main is placed in service, collect bacteriological quality samples at each of following locations and other locations in accordance with the submitted disinfection test plan and Standard Methods for the Examination of Water and Wastewater:
   a. Where water enters system.
   b. Ends of piping runs.
   c. Remote outlets.
   d. Tanks.
   e. At least two (2) outlets on each building floor.
4. Analyze water samples in accordance with Standard Methods for Examination of Water and Wastewater.
5. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment.
6. Bacteriological Sampling for the treatment equipment shall be in accordance with section 5.1 of the AWWA C653-13.

B. Equipment and Facilities Testing
   1. The facility must be shut down overnight prior to sample collection.

END OF SECTION 33 13 00

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Storm drainage piping.
   2. Catch basins.

B. Related Sections:
   1. Section 31 23 17 – Trenching.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
   1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   5. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
   6. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
   7. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
   8. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
   9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   11. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
   12. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   13. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   14. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

15. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
16. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
17. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
18. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
19. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. Civil/ Site Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Requirements for submittals.

B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Requirements for submittals.

B. Project Record Documents:
1. Accurately record actual locations of pipe runs, connections, catch basins, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Nassau County Department of Public Works standards.

B. Maintain one copy of each document on site.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 20 20 – Progress Meetings: Pre-installation meeting.

1.7 COORDINATION

A. Section 01 31 00 - Coordination: Coordination and project conditions.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. ADS N-1.2 Corrugated Polyethylene Pipe.

2.2 CATCH BASINS

A. Furnish materials in accordance with Nassau County Department of Public Works standards.

2.3 BEDDING AND BACKFILL MATERIALS

A. Bedding: As per section 31 23 23 Fill.

B. Backfilling: As specified in Section 31 23 23 Fill.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify trench cut is trimmed, compacted and ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 31 23 17 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with Nassau County Department of Public Works standards.

3.5 INSTALLATION - CATCH BASINS

A. Install Work in accordance with Nassau County Department of Public Works standards.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

C. Compaction Testing: In accordance with ASTM D1557.

D. When tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Compaction Tests: one test per 20 liner feet of trench per lift.

3.7 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution Requirements and 01 77 00 Closeout Procedures: Protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
   1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
   2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION 33 41 00

SECTION 40 22 00 - PETROLEUM PRODUCTS PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

The Contractor shall procure and furnish all labor, material, tools and equipment required to install all piping, valves, fittings, and appurtenances for the installation of fuel systems as indicated on the Contract Drawings, specified herein, or as required by the Construction Manager.

1.2 RELATED WORK:

SECTION 23 13 13: FACILITY UNDERGROUND FUEL STORAGE TANKS
SECTION 40 70 00: INSTRUMENTATION FOR PROCESS SYSTEMS

1.3 APPLICABLE REFERENCES:

The following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation and shall be the latest published versions.

A. American Society for Testing and Materials (ASTM)

ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM D 2996 Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

B. National Fire Protection Association

NFPA 30 Flammable and Combustible Liquids Code

C. Piping and accessories shall comply with ANSI, ASME, AWWA, ISA, and all other applicable federal, State, and Municipal Codes including revisions to date of the Contract.

1.4 SUBMITTALS:

A. The Contractor shall submit manufacturer’s specifications, catalog cuts indicating pipe sizes, material type, etc., installation instructions, and pipe test results.

B. Where necessary for the installation of piping to penetrate through concrete or brick masonry, the Contractor shall provide a plan showing the proposed location and penetration size required.

C. Where necessary for the installation of piping to penetrate through grade beams, the Contractor shall provide a plan showing the proposed location and penetration size required.

PART 2 - PRODUCTS

2.1 UNDERGROUND PIPING AND FITTINGS:

A. All primary buried piping shall be fiberglass pipe and fittings for underground petroleum installations, and shall be Smith Fibercast Red Thread II, NOV Dualoy 3000/L, or an approved equal.

B. All double wall piping systems shall be NOV Dualoy 3000/LCX, or an approved equal.

C. All fiberglass piping and fitting joints shall be bonded. The primary pipe shall have a minimum pressure rating of 175 psig. The primary fittings shall have a minimum pressure rating of 100 psig.

D. The outer containment piping shall be a non-permeable sleeve designed to retain any leakage and to channel such leakage as appropriate to a location equipped with a continuous automatically monitored leak detection system. The piping shall provide 100% containment of the primary piping, including the flexible connectors. The leak detection system shall be as specified in SECTION 40 70 00: INSTRUMENTATION FOR PROCESS SYSTEMS.

E. Vent Pipes: All buried vent piping shall be Smith Fibercast Red Thread II, NOV Dualoy 3000/L fiberglass pipe and fittings for underground petroleum installations, or an approved equal.

F. Piping, fittings, components and joint compounds used shall be mutually compatible with the appropriate fuel for which it is used. Joint compounds shall be listed and approved.

G. Single wall sump entry fittings for 2" 3000/L fiberglass piping shall be model 012020-628-0 as manufactured by Ameron, FEB-175-SC as manufactured by Franklin Fueling Systems, or approved equal.

H. Double wall sump entry fittings shall be designed for 2" DW fiberglass piping. Acceptable models are 22856821 as manufactured by Dualoy, 012020-629-0 as manufactured by Ameron, or approved equal.

2.2 ABOVEGROUND PIPE FITTINGS:

A. All fittings and connections shall be the screw-type except where indicated on the Contract Drawings, or specified herein.

B. All fittings, unless otherwise specified, shall be urethane-coated malleable iron, Class 150, with a working pressure of 300 psi at 150 degrees F. Valves shall be as manufactured by Stockham Valves and Fittings, or an approved equal.

C. Unions shall have bronze to bronze seats and shall be furnished and installed adjacent to, and on, the downstream side of each threaded-end valve and as shown on the Contract Drawings, or as approved by the Construction Manager.

D. Flanged connections may be used where indicated on the Contract Drawings and where necessary with the approval of the Construction Manager.

2.3 DROP TUBE:

A submerged drop tube shall be furnished and installed in the fill line of each petroleum storage tank as indicated on the Contract Drawings. Drop tube shall be Franklin Fueling Systems model 782-204-1D-2, or approved equal. An overfill prevention valve shall be installed on the drop tube.

2.4 VENT RISERS:

All above ground vent risers, unless otherwise specified, shall be standard weight, Schedule 40, galvanized steel pipe, ASTM A 53, Grade B welded.

2.5 VENT CAPS FOR GASOLINE:

A. A pressure vacuum vent cap shall be installed at the end of each gasoline vent riser. Vent caps shall be of all metal and corrosion-resistant composite construction, contain a flame-retardant 40 mesh stainless steel screen, and shall conform to NFPA 30. All vent caps shall prevent water and contaminants from entering the tank, and assure easy runoff from precipitation.

B. Vent caps shall contain a normally-closed poppet that opens at a predetermined pressure or vacuum setting allowing the tank to vent.

C. Tank vent caps shall be Morrison Bros 749 Series pressure vacuum vent, or approved equal.

2.6 EXTRACTOR FITTINGS:

A. Each underground suction line shall have an extractor fitting, Morrison Bros. Co. Model 561, or an approved equal, located in the sump mounted to the tank manway cover.

B. The extractor fitting shall have a cast-iron epoxy-coated body with a brass extractable cage.

2.7 FLEXIBLE CONNECTORS:

A. Flexible connectors shall be installed in all piping lines as indicated on the Contract Drawings. The connectors shall be UL-listed.

B. The flexible connectors used in tank sumps and below grade shall be constructed of 300 series stainless steel braid reinforcement and innercore. The flexible connectors shall be OPW Stainless Steel Flexible Connectors as manufactured by Hose Master, or an approved equal.

2.8 BALL VALVE:

A. The gasoline suction line shall be equipped with a 2” stainless steel full port ball valve designed for stopping the flow of fuel. The valve shall be model 21BV-0200SS, as manufactured by OPW, or an approved equal.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

A. All piping shall be installed in pea gravel, in accordance with the Manufacturer's recommendations, applicable codes, and as shown on Contract Drawings.

B. All suction, vent, and vapor recovery lines shall be sloped towards the storage tank at a minimum of 1 inch per 8 foot of pipe, or as approved by the Construction Manager.

C. Vent Pipes: Each tank shall be provided with a separate vent pipe.

1. It shall not be less than 2 inches in diameter and shall run from the tank to the outer air.
2. Terminate at a height greater than the fill pipe opening, at least 15 feet above adjacent grade.

3. Vapors shall be discharged upward or horizontally away from adjacent walls to assist in vapor dispersion.
4. Vent outlets shall be located such that flammable or combustible vapors will not be trapped by eaves or other obstructions and shall be at least 10 feet from building openings.
5. The vent piping shall be well braced in position.
6. Vent pipes shall terminate out-of-doors in a non-hazardous location.
7. No vent pipe shall be obstructed by devices that reduce its capacity and thus cause excessive back pressure.
8. Final location and height shall be as approved by the Construction Manager and in accordance with regulations.

D. All pipes and valves, except where otherwise indicated, shall be arranged to be easily accessible for maintenance and repairs, and no change in the general arrangement indicated on the Contract Drawings will be allowed unless approved by the Construction Manager. Piping shall be located such that it is protected from physical damage. Where lengths of pipe are finally assembled, the fittings shall be in correct alignment without forcing them into position.

E. All pipes shall be accurately cut. Deformed or damaged pipe shall not be used. All bends shall be made with standard elbows and fittings. All threads shall be cleaned thoroughly and covered with suitable joint compound before joints are made. Every piece of pipe, valve and fitting which is part of the pipe work shall be cleaned thoroughly before and, whenever possible, after installation.

F. All piping shall be installed true to line and grade and be supported by suitable supports, spaced not more than 8 feet on centers. All such supports, anchors, clamps or other devices shall be of standard design, simple in installation, and of an approved manufacturer.

G. Hangers, brackets, supports, anchors, clamps, and other devices shall be hot-dip galvanized after fabrication and before assembly and installation. They shall be installed to make the entire pipe system self-supporting and rigid. Defective or inaccurately constructed hangers, brackets, supports, clamps, and other hardware shall not be used. Machine bolts, 5/8-inch in diameter and of proper length shall be used throughout for securing the hangers, brackets, clamps, and supports for pipes larger than 3 inches, and 1/2-inch diameter bolts for pipes 3 inches and smaller.

H. Where required to use expansion bolts for securing supports and hangers, the holes in the masonry shall be drilled to the exact size of the bolts or sleeves. No packing shall be used. Expansion bolts shall be of an approved type, diameter, and length.

I. All flanged and mechanical coupling connections shall be made with bolts and nuts of the length and diameter required for the particular flange size as determined by the ANSI.

J. Proper allowance for expansion and contraction shall be made. Wherever the pipe lengths required are to exact dimensions, and where lengths of pipe are finally assembled, the flanges and fittings shall be in correct alignment without forcing into position.

K. Ball valves are required for all suction lines, and valve stems shall be vertical where possible and in no case below a horizontal position.

L. The pipe to be installed shall be free of flaws, blisters, cracks, and all other imperfections or defects which would impair its quality. All pipe shall be tested by the manufacturer under standard test pressure.

3.2 FLEXIBLE CONNECTORS:

The length of the flexible connector shall be adequate to relieve stresses due to movement, settlement, and shifting of the tank and piping, or due to vibration, traffic, etc., and shall be installed so as not to have less than the minimum bending radius of the connectors as recommended by the manufacturer. It shall not transmit excess stress to the threads of associated fiberglass piping. When the connector is bent, it shall not be distorted out of shape, and its diameter shall not be constricted or obstructed.

3.3 SLEEVING OF MASONRY:

Where necessary for the installation of piping to penetrate through concrete or brick masonry, the Contractor shall install a sleeve at the proposed location during concrete or brick masonry installation. The Contractor shall insure the penetration is sealed watertight after pipe installation.

3.4 SLEEVING OF GRADE BEAMS:

Where necessary for the installation of piping to penetrate through grade beams, the Contractor shall install a sleeve at the proposed location during grade beam installation. The Contractor shall insure the penetration is sealed watertight after pipe installation.

3.5 TESTING:

A. The piping systems of this Specification shall be tested as indicated on the Contract Drawings and/or as specified herein. Each test shall be performed in the presence of the Construction Manager. The Contractor shall provide water, air, and all labor, equipment, and accessories required to perform the tests at no additional cost to the County or the Construction Manager.

B. Defective pipes and fittings shall be replaced by the Contractor at his own expense with sound material. All joints examined during the tests and found to be leaking shall be repaired or otherwise made satisfactory in the opinion of the Construction Manager. Tests shall continue until a passing test is achieved.

C. All test gauges shall be certified for accuracy.

D. All instruments other than test instruments shall be disconnected during testing to prevent damage.

E. The interstitial space of each piping system shall be monitored at all times using Veeder Root Console and leak detection equipment.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 70 00 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

This section specifies the requirements for the instrumentation and control equipment to be used for process control, motor-operated machinery, and other equipment. For the replacement of storage tank systems, all instrumentation and control equipment shall be furnished and installed in the system, completed, tested, and placed in operation as indicated on the Contract Drawings, specified herein or as required by the Construction Manager. For the relocation of system controllers, the Contractor shall provide all labor, equipment, tools and materials required for a complete reinstallation. Relocated equipment shall be tested and placed in operation as indicated on the Contract Drawings, specified herein or as required by the Construction Manager.

1.2 APPLICABLE STANDARDS:

All instrumentation and control equipment shall comply with the following standards and all other applicable federal, state, and the Nassau County Public Health Ordinance including revisions to the date of Contract.

ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
ASME	American Society of Mechanical Engineers
NEC	National Electric Code
ISA	Instrumentation Society of America

1.3 SUBMITTALS:

A. Shop Drawings: Shop drawing submittals shall include, but not be limited to the following:

1. Wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.
2. Equipment list, including size, input/output types, expected range of operation, utility requirements, and materials of construction. A Bill of Materials also shall be included and keyed to the drawings. The Bill of Materials shall provide sufficient information to determine compliance with the Contract Drawings and Specifications.
3. Drawings showing the proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of work, including clearances for maintenance and operation.
4. Manufacturers' descriptive and technical literature, including catalog cuts.
5. Legends for name plates.
6. Control panel and enclosure drawings providing arrangements, dimensions, cabinet door swing radii, and terminations for all panels.
7. Equipment certifications and test reports.

B. Spare Parts Data: Within five (5) days of Shop Drawings approval, the Contractor shall furnish spare parts data for each different item of material and equipment specified.

1. Data shall include a complete list of parts and supplies, with current unit prices and a source of supply. A list of all special tools required for installation, maintenance or repair of equipment shall be provided.

2. The Contractor shall furnish those spare parts and special tools which are recommended by the manufacturers.

3. The Contractor also shall provide a 12-month supply of any expendable items and frequently replaced parts as identified by the manufacturer.

C. Operation & Maintenance Manuals: Operating and maintenance instructions shall be provided for each different type of control, instrument, and system, as required by the Construction Manager.

1. The Contractor shall furnish to the Construction Manager, five (5) complete copies of the operating instructions outlining the procedures required for equipment and system start-up, operation, and shut-down. The instructions shall include the manufacturer's name, model number, service manual, parts list, and a brief description of all equipment and their basic operating features.

2. The Contractor shall furnish to the Construction Manager, five (5) complete copies of maintenance instructions listing routine maintenance procedures, possible breakdown and repairs, troubleshooting guide, and manufacturer's contact address and phone numbers. The maintenance instructions shall also be provided in electronic format.

D. Performance Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of the controls.

1.4 MANUFACTURER'S SERVICES:

The Contractor shall provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the instruments and controls specified to be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.5 FIELD TRAINING:

The Contractor shall provide a field training course for designated operating staff. Training shall be provided for a total of 24 hours of normal working time (for each shift), and shall be completed prior to the system's final acceptance by the County. Field training shall cover all of the items contained in the operating and maintenance manuals. Costs for these services shall be included in the Contract Bid Price.

PART 2 - PRODUCTS

2.1 GENERAL:

The general instrumentation requirements are identified on the Contract Drawings. All instruments and control equipment shall conform to the following general provisions.

A. All equipment in a system shall be compatible in function and appearance. Provisions shall be made, where necessary, for signal dampening to suppress noise and spurious electrical signals in order to provide the desired degree of performance.

B. All instrument supports and interconnecting wiring and conduit shall be as recommended by

the manufacturer and approved by the Engineer.

C. Identifying tag number for each instrument shall be permanently etched or embossed onto a durable tag which shall be fastened to the device housing with stainless steel rivets or self-tapping, stainless-steel screws of appropriate size. Where neither of the above fastening can be accomplished, tag number nameplates shall be permanently attached to the device by a circlet of stainless-steel wire.

D. All instruments and devices furnished under this Section requiring electrical power shall be suitable for operation on a 120 Volt +/-10%, 60 Hertz +/-2 Hertz supply.

E. All instruments shall return to accurate measurement upon restoration of power after a power failure.

F. Unless otherwise noted, all instruments in contact with a process stream shall be furnished with diaphragm seals.

G. Instruments shall be guaranteed to maintain the characteristics listed herein and under conditions listed and shall meet the following specifications, except where otherwise noted:

1. Accuracy +/-1% of span
2. Repeatability: +/-0.1% of span
3. Dead Band: +/-1% of span (where applicable) in accordance with ISA Standard S50.1
4. All signal generators and transmitters shall be capable of operating at a load of 600 ohm in accordance with ISA Standard S50.1, higher when specified. Signals shall be output isolated.
5. All electronic instruments shall be solid-state and shall be capable of operating throughout the temperature range of 10 degrees Fahrenheit to 110 degrees Fahrenheit, unless otherwise specified.
6. Temperature effect on calibration shall be equal to or less than 1% over a temperature change of 100 degrees Fahrenheit.

H. The ranges and scales shall be as per specified, shown on the Contract Drawings or approved by the Construction Manager.

I. Where separate measuring elements and transmitters are required, they shall be fully matched and any special cables or equipment required must be supplied for installation.

J. The Contractor shall be responsible for the matching of electrical characteristics of instruments and shall supply transmitters with ample signal output capacity. Additional signal generators or repeaters shall be avoided if possible, but must be supplied if necessary.

K. All equipment, unless otherwise specified, shall be furnished in the manufacturer's standard enclosure for the service indicated by the equipment location.

L. All miscellaneous necessary work required to complete installation shall be included. This work includes, but is not limited to, bolts, nuts, studs, gaskets, pipe tapping, holes through walls, and repair.

M. Electrical control conductors shall be No. 14 AWG or larger. Conductors larger than No. 14 shall be used where herein specified, or where indicated on the Contract Drawings.

N. The size of the conductors and other current-carrying parts of switches and control equipment shall be ample for the rating of the devices to which they are to be connected for service, without undue heating. In no case shall the current density exceed 1,000 amperes per square

inch of cross-section. At contacts, the current density shall not exceed 150 amperes per square inch.

2.2 LEAK DETECTION/INVENTORY CONTROL:

A. The leak detection/inventory control system shall include all parts, equipment, and software necessary for a complete system. The leak detection/inventory control system shall include, but not be limited to, the following:

1. One (1) monitoring head/system controller capable of controlling 32 tank probes and associated sensors
2. One (1) magnetostrictive type, inventory control and in-tank leak testing probe assembly (one required per tank)
3. One (1) annular space liquid sensing probe for interstitial space (per double-wall tank, one required)
4. Four (4) magnetostrictive liquid sensing probe for tank-top containment and dispenser sump (one required per sump)
5. One (1) overfill alarm with acknowledgment switch
6. One (1) 5 dry contact module
7. Total Access software for PC or PDA
8. 3-year back up reports for alarms, compliance, inventory and level readings
9. Automatic reconciliation.
10. Accu Chart II software program
11. Ethernet TCP/IP
12. One (1) fax modem
13. Stick gauge calibrated in inches (one (1) required per UST located outdoors)

The Contractor shall refer to Drawing FS.009 of the Contract Drawings for additional equipment references.

B. The controller shall be capable of performing in-tank leak detection functions, business inventory reconciliation (BIR) functions, AccuChart 3.0 tank charting, Continuous Statistical Leak Detection, Ultimate testing leak detection, and external leak detection functions. The controller shall be completely compatible with all probes, sensors, etc. The controller shall have an 8" high resolution full WVGA LCD touch screen, displaying inventory, system status, setup, and diagnostics. The system shall be programmable using the touch screen or through remote access. The controller shall be supplied with an integral printer. The controller shall be supplied with an internal telephone fax/modem. The fax/modem shall be capable of dialing a pre-programmed telephone number at operator specified alarm or inventory conditions. The Controller must be capable of sending email alarms to 25 email addresses. The controller shall include all software and interface modules required for probes, sensors, alarms, modems, and other input/output devices required for a complete system. The controller shall be model TLS-450Plus Automatic Tank Gauge with Integral Printer, Model 860091-301 and with SiteFax Fax/Modem Model No. 332818-001, as manufactured by Veeder-Root, of Simsbury, Connecticut (Veeder-Root), or an approved equal.

C. The inventory control and in-tank testing probe assembly shall be of the magnetostrictive technology type. The in-tank probe shall be capable of measuring product level in the tank in inches, and detecting the presence of water in the tank in inches. The probe shall be capable of performing the 0.1 gallon per hour (gph) volumetric tank tightness testing and 0.2 gph automatic tank gauging in the tank system. The probe shall meet NEC, NFPA, and UL requirements for hazardous locations. Probe electronics shall be capable of operating from -

40 Celsius to +50 Celsius. The in-tank probe assembly shall include 4-inch floats and be installed using a 4-inch sealed riser cap and ring kit Model No. 312020-952. Each probe shall be completely compatible with the fluid to be stored in the tank. The probe shall be Series 846397 Mag Plus Probe. Each Probe must include a 4-inch Float Installation Kit, Model No. 886100-000 (gas). At a minimum, each controller shall be equipped with one (1), sixteen (16) input Universal Sensor/Probe Interface Module Model No. 332812-001, one (1) Universal Input/Output Interface Module Model 332813-001, one (1) BIR/AccuChart II LVDIM 12 Input Factory Installed Model 333151-001, and one (1) BIR/AccuChart II MDIM 12 Input Factory Installed Model 333152-001 as manufactured by Veeder-Root, of Simsbury, Connecticut, or an approved equal.

D. The interstitial sensor shall be capable of detecting liquid hydrocarbons and other liquids in the interstitial space between tank walls. The sensor shall meet NEC, NFPA, and UL requirements for hazardous locations. Sensor electronics shall be capable of operating from -40 degrees Celsius to +70 degrees Celsius. Annular space sensor shall be Series 794380-343 Discriminating Interstitial Sensor For Fiberglass Tanks, as manufactured by Veeder-Root, of Simsbury, Connecticut, or an approved equal.

E. The sump sensor shall be capable of detecting and differentiating between liquid hydrocarbons and other liquids in the tank-top containment and dispenser sump reporting the level of the liquid in inches. The probe shall meet NEC, NFPA, and UL requirements for hazardous locations, and shall be capable of withstanding the harsh environment and wide temperature ranges possible in the intended location. Containment sump sensor shall be Series 857080 Mag Sump Sensor as manufactured by Veeder-Root, of Simsbury, Connecticut, or an approved equal.

F. The overfill alarm shall be the audible horn and flashing light type. The overfill alarm shall be supplied with an alarm acknowledgment switch. Alarm electronics shall be capable of operating from -40 degrees Fahrenheit to +150 degrees Fahrenheit. The alarm and acknowledgment switch shall be Series 7900 Overfill Alarm and Alarm Acknowledgment Switch, Models No. 790091-001 and 790095-001, as manufactured by Veeder-Root or an approved equal. Controller shall be equipped with Four-Relay Output Interface Module, Model No. 329359-001, as manufactured by Veeder-Root or an approved equal.

G. The pulser/totalizer shall be capable of totalizing product flow through the hose assembly in the dispenser, and sending a signal back to the controller. The pulser/totalizer shall be capable of performing business inventory reconciliation (BIR) functions. The pulser/totalizer shall be compatible with the dispensers. The controller shall be equipped with an interface module compatible with the pulser/totalizer. The pulser/totalizer shall be Model 787491-003, Mechanical Dispenser Pulse/Totalizer, as manufactured by Veeder-Root or an approved equal. Controller shall be equipped with Low Voltage Dispenser Interface Module (LVDIM), Model 847490-206, as manufactured by Veeder-Root or an approved equal.

H. The user interface is a 8 inch WVGA touch screen. The system must be able to supply a replenishment recommendation. Alarm messages must be customized to user specific wording. Unit will support email alarm and report notification.

PART 3 - EXECUTION

3.1 GENERAL:

A. Installation of all equipment shall be in accordance with building codes, and the NFPA, NEC,

and NEMA codes. The Contractor shall furnish and install all required conduit sealing fittings, explosion-proof accessories, and NEMA Type 7 enclosures where indicated on the Contract Drawings, or where required by Code, or both.

B. The locations shown for instrumentation and control equipment on the Contract Drawings are approximate. The Contractor shall field locate as directed by the Engineer. The Contractor shall field locate the new TLS-450 Plus controller at a location which is accessible and visible from an occupied work station. All power and control wiring and connections not specifically indicated on the Contract Drawings, but required for the proper operation of equipment shall be made by the Contractor in accordance with these Specifications. All electrical control and instrumentation equipment installed in Class 1 hazardous locations shall be installed in NEMA Type 7 enclosures. Conduits and wireways leading to and from these areas shall be provided with sealing fittings. All non-conducting metal parts of switches and control shall be rust-proofed by galvanizing, cadmium plating, baked enamel or by the use of a non-corroding metal. Springs, wherever used, shall be a phosphor bronze.

C. Each leak detection inventory control system shall be installed, programmed and adjusted in accordance with the manufacturer's instructions so that all components function properly. Each overfill alarm and alarm acknowledgement switch shall be programmed and adjusted so that the alarm is activated at 90 percent of the tank capacity.

3.2 SYSTEM CONTROLLER

The Contractor shall set-up the system controller to enable 20 point control monitoring.

3.3 TESTING:

A. General: All equipment (hardware and software) shall be factory and field tested to demonstrate that it provides the specified functions.

B. The factory and on-site test procedures shall be submitted to the Construction Manager for approval prior to starting the actual tests.

C. The on-site testing shall include checking of cables, testing of system subassemblies and checking of connections for each component and for the entire instrumentation and control system.

D. The Construction Manager will authorize the start of testing at a mutually-agreed starting date. When the Contractor is ready and desires to start onsite system testing, the Contractor shall notify the Construction Manager in writing.

E. Shop Testing: All activating devices, instruments, and assemblies furnished under this item shall be set up in the shop of the manufacturer and tested over the full range of the equipment. The equipment shall satisfactorily perform all the functions within the requirements of the specifications.

F. Field Testing: All instruments and systems shall be tested to ensure conformance with the Specifications. Control systems shall receive dynamic loop tests which shall conform to the intent of ANSI: MC4.1 (ISA-S26). The control systems and equipment shall include provisions for such testing.

G. Input signals for equipment control shall be simulated for at least 20 signal values from 0 to 100 percent signal, with corresponding equipment response to be manually recorded, and adjustments made as required. Output signals from the equipment shall be read for at least

20 signal values from 0 to 100 percent of the meaningful process values, and adjustments shall be made as required.

H. All instruments used for control functions shall be tested with the final elements in the circuit in addition to simulated control methods. The Contractor shall adjust instruments and/or final elements to obtain the best working conditions for a dynamic system.

END OF SECTION 40 70 00

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Limited Subsurface Soil Investigation

for property known as

Nassau County 2nd Precinct

770 Jericho Turnpike
Westbury, NY 11590

Report prepared for

LiRo Group
235 E. Jericho Turnpike
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January 24, 2023

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Limited Subsurface Soil Investigation

for property known as

NCPD 2nd Precinct

7700 Jericho Turnpike
Westbury, NY 11590

1.0 GENERAL

This report describes the findings of a limited investigation regarding the geotechnical characteristics of the soils present on a property known as NCPD 2nd Precinct located at 7700 Jericho Turnpike in Westbury, NY 11590. The subject investigation comprises of soil borings for the purpose of investigating the geotechnical properties of the subsurface soils present at this location. The investigation was performed at the locations as directed by the client and as shown in the Appendix of the boring location plan. The investigation included collection and analysis of limited subsoil conditions present at the site for site improvements and included drilling of four (4) tests for:

- Nassau County 2nd Precinct Building Replacement

As a result, in January of 2023, UTIS investigated four (4) test locations to analyze the sub-surface soil conditions present at the subject property. The work included the drilling of four (4) borings in test locations as requested by the Client. A total drilling depth of 109-feet and 32 split spoon samples to investigate the geotechnical properties.

Ground water was not encountered at any of the four (4) boring locations on the day of boring.

2.0 GEOTECHNICAL SUB-SURFACE SOIL INVESTIGATION METHODOLOGY

To determine the subsurface soil conditions, Universal Drilling + Boring, a division of Universal Testing and Inspection Services, Inc. (UTIS) conducted the soil borings at the location as chosen by the client and at a location as shown on the enclosed Test Boring Location Plan. The soil boring was taken at the subject location of the property in the month of January 2023. The soil borings were collected based on the existing site conditions at the time of boring and as instructed by the client on the day of the site investigation. Select samples were collected to analyze the soil properties to the depth specified in the contract. The borings were as directed by the client and was located as shown in the attachment.

As requested by the client, the borings were for the burned building replacement and general construction. UTIS did continuous sampling of the first five feet for this boring to more accurately determine the geotechnical properties of the existing soils and to classify the soil composition for reporting purposes.

The collection of borings was performed using a mobile truck-mounted rig. Standard Penetration Test (STP) was performed within the proposed construction area as designated by the project management team. The drilling rig was equipped with a 4-1/4-inch auger. The rig used was a CME 45 C drill with an automatic STP Hammer Rig and 2018 Fort F550 Support Truck. The rig was equipped with a 30-inch drop for the hammer, and a 140-pound spoon sampler. The hollow stem auger was used to advance the boreholes and facilitate subsurface testing and sampling. Representative samples were routinely obtained during the drilling process at selected intervals by penetrating a two-inch diameter split spoon sampling tube.

The soil descriptions shown on the test boring logs (attached) are based on the

- visual characteristics of the soil, in terms of color, texture, and wetness, recorded for five-foot intervals through the soil column.

- The number of blows required to drive the sampler per foot were record as the standard penetration resistance (N), which is an indicator of the soil bearing capacity and its insitu state of compactness.

- depth to groundwater if encountered.

The drilling and testing procedures were performed by applying the guidelines and procedures of the following ASTM designations.

- D-1586 - Standard Test Method for Penetration Test and Split Barrel Sampling of Soils
- D-1587 - Standard Practices for Thin-Walled Tube Geotechnical Sampling of Soils
- D-2488 - Standard Practices for Description and Identification of Soils (Visual-Manual Procedure)

3.0 OBSERVATIONS AND ANALYSIS OF THE RESULTS OF GEOTECHNICAL SOIL INVESTIGATION

The field data sheets taken during the boring is included in the Appendix. The subsurface soil conditions encountered in the test boring may be summarized as follows:

- Visual observations in the field revealed that the soils at the subject location generally consist of brown fine to medium sands with gravel and silt throughout the depth of investigation. With the increase in depth, the soils typically remained the same. The soil characteristics remained the same for the depth of the boring based on the sampling and visual inspection through the final depth of this borings. For a detailed description of each sample collected at this boring refer to the boring log kept by the driller and attached in the Appendix.

- Blow counts for all Standard Penetration Tests were recorded for a six-inch advancement of the spoon at five-foot intervals and were relatively consistent to the depth at which the borings were terminated. The borings were terminated at a depth ranging between 22 to 32 feet from the existing ground level. Ground water was not encountered at any boring location.

BORINGS FOR GENERAL CONSTRUCTION

The field data sheets taken during the boring is included in the Appendix. Details of the soils encountered during the investigation are presented in the boring logs. The subsurface soil conditions encountered in the test boring may be summarized as follows to a depth of the boring.

- B-1: The soil materials consisted of Brown Fine Sand and Gravel topped with Asphalt Pavement and an RCA Type Subbase for the first 2 feet followed by Brown Fine Sand and Gravel with Trace Silt from 2’ to 4’, Brown Fine Sand with a Trace of Silt from 4’ to 25’ and Brown Fine Sand from 25’ to 32’, where the boring was terminated. A blow count of 9 blows per foot was recorded at a depth of 5 feet. A maximum blow count of 26 blows per foot was recorded at a depth of 16 feet from the ground surface. The soils were observed to be classified SP and SM per the Unified Soil Classification Symbol USCS. Ground water was not encountered at this location.

- B-2: The soil materials consisted of Brown Fine Sand and Gravel topped with Asphalt Pavement and a Stone Subbase for the first 2 feet followed by Brown Fine Sand with Gravel from 2’ to 20’, Brown Fine Sand and Gravel with Trace Silt from 20’ to 25’, Brown Fine Sand and Gravel from 25’ to 30’ and Brown Fine Sand from 30’ to 32’, where the boring was terminated. A blow count of 6 blows per foot was recorded at a depth of 5 feet. A maximum blow count of 25 blows per foot was recorded at a depth of 2 feet from the ground surface. The soils were observed to be classified SP per the Unified Soil Classification Symbol USCS. Ground water was not encountered at this location.

- B-3: The soil materials consisted of Brown Fine Sand and Gravel topped with Asphalt Pavement and a Stone Subbase for the first 2 feet followed by Brown Fine Sand with Gravel from 2’ to 4’, Reddish Brown Fine to Medium Sand with Gravel and a Trace of Silt from 4’ to 6’, Dark Brown Fine Sand with Silt and Trace Organics from 6’ to 8’, Dark Brown Fine to Medium Sand with Gravel from 8’ to 15’, Brown Fine Sand with Gravel from 15’ to 20’ and

Brown Fine to Medium Sand with Large Gravel from 20’ to 23’, where a refusal was encountered and the boring was terminated. A blow count of 15 blows per foot was recorded at a depth of 5 feet. A maximum blow count of 50+ blows per foot was recorded at a depth of 20 feet from the ground surface. The soils were observed to be classified SP, GM, SM, and PT per the Unified Soil Classification Symbol USCS. Ground water was not encountered at this location.

- B-4: The soil materials consisted of Brown Fine Sand with a Trace of Debris topped with Asphalt Pavement and a Stone Subbase for the first 2 feet followed by Brown Fine Sand with Silt and Some Gravel and a Trace of Concrete Debris from 2’ to 4’, Grey Fine Sand with Silt and Some Gravel from 4’ to 6’, Dark Brown Organic Soil with a Trace of Silt from 6’ to 8’, Brown Inorganic Clay from 8’ to 15’ and Brown Fine Sand with Some Gravel from 15’ to 22’ where the boring was terminated. A blow count of 11 blows per foot was recorded at a depth of 5 feet. A maximum blow count of 31 blows per foot was recorded at a depth of 2 feet from the ground surface. The soils were observed to be classified SP, GM, PT, and CL per the Unified Soil Classification Symbol USCS. Ground water was not encountered at this location.

4.0 RECOMMENDATIONS FOR VARIOUS CONSTRUCTION ACTIVITIES

In accordance with the guidelines as requested in the engineering classification for soils "Unified Soil Classification" and it's various Soil Groups, and based on UTIS's professional judgment and experience, the insitu soils encountered are typical of the region and are granular with fine sand mixed with gravel materials.

GENERAL AREAS

Foundation Support and Design Criteria

Based on the review of the four (4) soil borings profiles investigated in January 2023, it is our opinion that the proposed building may be supported on properly typical spread footings. Our analysis suggests that spread footings bearing on natural soils at a minimum depth of four feet below existing grade can be designed using a maximum allowable bearing capacity of 1.25 Tons/SqFt. for footing widths 4 feet or less and 1 Tons/SqFt. for footing widths greater than 4 feet for all areas investigated. All footing subgrade is to be subject to controlled inspection as per NYS Building Code by a qualified geotechnical engineer prior to placing steel reinforcement and concrete. At the discretion of the inspecting geotechnical engineer, any unsuitable bearing materials should be removed and replaced with controlled compacted fill. The new fill should meet the grading requirements as stipulated in the Code. Controlled fill should be placed in maximum 12" loose lifts and each lift should be compacted to at least 95% of its maximum dry density as determined in accordance with ASTM D1557.

Established sites containing homogeneous granular, cohesionless soils, including sandy soils, with little silt and gravel mixture are generally suitable for conventional spread footings. Any soil replacement must extend several feet beyond and below the perimeter and base of the proposed footing. Thorough compaction of the engineered soil verified by density measurement is critical to ensure the influence of any loose material is substantially mitigated.

Overall, the results of the limited subsurface investigation indicate that the proposed construction should be adequately supported on spread footings. All loose and organic soils if encountered should be removed and replaced with control structural fill materials, such as recycled concrete aggregate to a depth as indicated, possibly to the existing groundwater. These soils will have to be compacted to the full depth of the structural fill placement.

In addition, the placement and compaction of these underlying soil materials should be subjected to quality control and inspection in accordance with the recommendations contained herein. Supplemental evaluation and inspection of existing fill materials prior to construction should be conducted in order to confirm conditions consistent with those identified by the soil borings or to identify areas that would require localized over-excavation and backfilling for the installation of the slab on grade slabs for non-load bearing structural members such as floors.

Design Recommendations and Design Consideration for the extension of the building

a) Foundation Walls: Foundation walls shall be designed and constructed in accordance with Sections 1807.1.1 through 1807.1.6. Foundation walls shall be supported by foundations designed in accordance with Section 1808 of the IBC 2020.

Design Lateral Soil Loads: Foundation walls shall be designed for the lateral soil loads set forth in Section 1610 of the IBC 2020.

b) Retaining Walls: Retaining walls shall be designed in accordance Sections 1807.2.1 through 1807.2.3. In addition, retaining walls shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, lateral soil pressures on both sides of the keyway shall be considered in the sliding analysis.

- Design Lateral Soil Loads: Retaining walls shall be designed for the lateral soil loads set forth in Section 1610 of the IBC 2020.

- Safety Factor: Retaining walls shall be designed to resist the lateral action of soil to produce sliding and overturning with a minimum safety factor of 1.5 in each case. The load combinations of Section 1605 shall not apply to this requirement. Instead, design shall be based on 0.7 times nominal earthquake loads, 1.0 times other nominal loads, and investigation with one or more of the variable loads set to zero. The safety factor against lateral sliding shall be taken as the available soil resistance at the base of the retaining wall foundation divided by the net lateral force applied to the retaining wall.

c) Foundations: Foundations shall be designed and constructed in accordance with Sections 1808.2 through 1808.9. Shallow foundations shall also satisfy the requirements of Section 1809. Deep foundations shall also satisfy the requirements of Section 1810.

d) Foundations on or Adjacent to Slopes: The placement of buildings and structures on or adjacent to slopes steeper than one unit vertical in three units horizontal (33.3-percent slope) shall comply with Sections 1808.7.1 through 1808.7.5.

e) Concrete Foundations: The design, materials and construction of concrete foundations shall comply with Sections 1808.8.1 through 1808.8.6 and the provisions of Chapter 19.

f) Shallow Foundations: Shallow foundations shall be designed and constructed in accordance with Sections 1809.2 through 1809.13.

g) Soil Lateral Loads: Lateral loads on Foundation walls and retaining walls shall be designed to resist lateral soil loads. Soil loads specified in Table 1610.1 shall be used as the minimum design lateral soil loads unless determined otherwise by a geotechnical investigation in accordance with Section 1803. Foundation walls and other walls in which horizontal movement is restricted at the top shall be designed for at-rest pressure. Retaining walls free to move and rotate at the top shall be permitted to be designed for active pressure. Design lateral pressure from surcharge loads shall be added to the lateral earth pressure load. Design lateral

pressure shall be increased if soils at the site are expansive. Foundation walls shall be designed to support the weight of the full hydrostatic pressure of undrained backfill unless a drainage system is installed in accordance with Sections 1805.4.2 and 1805.4.3.

h) Earthquake Loads: The soils encountered during this investigation have been classified as Site Class D. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. of NYSCA. (See Attachment for detailed Seismic Computations).

i) Settlement: If soil disturbed during construction, the soil should be re-compacted to 95 percent modified proctor at or near optimal moisture content settlements should be less than one quarter of an inch. Settlement of properly designed steel reinforced spread footings on undisturbed soil should be less than one quarter of an inch. Fine dense soils at two tons per square foot bearing generally exhibit little or no issues with regard to settlement.

A. Shallow Foundation Design Criteria

Non-structural bearing loading criteria for this site can be assumed based on the limited test borings. It can be summarized to have a presumptive soil bearing capacity of one ton per square foot. This, however, may not be the capacity of other areas of the site not investigated by this boring. The top layer of fill materials, (if encountered) should be removed to achieve proper bottom footing grade. In the top five-foot layer of soil, a lateral bearing capacity of one hundred pounds per square foot of depth may be assumed. This value may be increased to one hundred fifty pounds per square foot per foot of depth below the five-foot depth.

Walls below grade should be constructed with a drainage system to prevent and minimize effects from ground water fluctuation and accumulation. Architectural and civil retaining walls shall be designed as gravity or reinforced soil wall type. All walls shall be backfilled with select granular fill to at least ninety-five percent Modified Proctor, ASTM D1587. Sub-base materials for walkways or other structure in backfilled areas, shall be compacted to ninety-five percent Modified Proctor.

Contingent on supplemental evaluation and approval of the existing fill, future structures on the subject property may be supported on conventional shallow spread and continuous wall footings designed to bear either upon the underlying natural soils, properly inspected and approved existing fill, or imported structural fill soils, provided that such materials are properly improved or placed as described. Foundations bearing within these materials may be designed to impart a maximum allowable bearing pressure as mentioned in the above section.

Additional precautions for moisture and drainage control under the slabs shall be considered. All of the sub-soils under the slabs shall be a minimum of 6” of RCA (or the thickness required to eliminate problematic subsoil conditions as directed by the engineer) and compacted to ninety-five percent Modified Proctor. All roots or other organic matter shall be removed prior to slab installation.

Slabs on grade

Any proposed basement floor slab may be designed and constructed as a slab-on-grade, bearing on competent natural sand soils or controlled compacted fill. It is recommended that the floor slabs be supported on at least 6 inches of ¾ inch crushed stone or gravel, which would provide uniform slab support and hydrostatic pressure relief in the event of a major water main break, or any other method designed/reviewed/and approved by the designer.

Prior to receiving crushed stone course, the slab subgrade should be subject to proof rolling to an unyielding consistency using a heavy vibratory roller. Any soft and/or unsuitable bearing material detected during the proof rolling should be removed and replaced with controlled compacted fill. Floor slabs supported on crushed stone over compacted subgrade may be designed using a modulus subgrade reaction of 150 pci (pounds per square inch per inch). Saw cuts and/or control joints should be provided in the concrete slab construction to control shrinkage cracks.

Foundation Drainage and under-slab drainage

Despite relatively deep-seated groundwater table, we suggest that foundation drainage be provided around the basement to ensure a free hydrostatic pressure condition behind the wall and to provide hydrostatic pressure relief in the event of a major water main break. Typical foundation drainage may consist of a 6” diameter perforated filter fabric-lined PVC or other approved pipe or drain tile, which should be covered with 6” of ¾” crushed stone in all directions. The designer should incorporate the thickness of the pipe, location of the pipe and the surrounding drainage areas including texture of the surrounding material and the slopes of the pipe.

Under-slab drainage is an option but not required. The water collected in the foundation drainage and/or under-slab drainage system should be directed and discharged into approved facilities.

B. Frost Coverage

Footings and pile caps subject to frost action should be placed at least 48 inches (or as recommended by the local codes) below adjacent exterior grades to provide protection from frost penetration. Interior footings not subject to frost action could be placed at a minimum depth of 18 inches below the slab sub-grade or as design analysis requires.

C. Earth Pressures on Building Walls

Any soil adjacent to the building walls will exert a horizontal pressure against the wall. This pressure is based on the soil density and Coefficient of Earth Pressure at Rest. The design should be performed to accommodate lateral earth pressures to the depth or height of the construction. Detailed engineering designs using available soil conditions should be performed under various soil conditions. The design also should include seismic design analysis, as discussed below.

E. Seismic and Liquefaction Considerations

Assuming that the type of building and the building category, etc., at the time of site investigation, to be constructed at the site, based on the for guidance in addressing seismic considerations for the proposed construction, the applicable seismic design parameters are based

on the local and regional authorities recommendations ascertained for the subject property. Structures should be designed to resist stresses produced by seismic forces computed in accordance with the latest version of the New York State Building Code as applicable. Refer to Attachment for analysis of the seismic considerations in detail. Following is a summary of the findings:

Seismic Design Coefficients

S_S	0.25	MCE_R ground motion. (for 0.2 second period)
S_1	0.048	MCE_R ground motion. (for 1.0s period)
SM_S	0.29	Site-modified spectral acceleration value
SM_1	0.1	Site-modified spectral acceleration value
SD_S	0.19	Numeric seismic design value at 0.2 second SA
SD_1	0.068	Numeric seismic design value at 1.0 second SA
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second

The soils encountered at the site, and typical soils and as result, an adequate factor of safety against liquefaction should be considered. Note that a seismic event could cause a momentary decrease in pore pressure allowing some consolidation of the soil around a foundation resulting in settlement. It is recommended that a factor of safety against liquefaction be considered. An analysis of the structure, once designed, based on a procedure by Idriss and Boulanger (2006) should be considered and performed to ascertain the actual factor of safety against liquefaction. Typical factors of safety for buildings and ancillary structures are 1.2 to 1.3.

D. Underpinning of foundations

If underpinning is anticipated, in general, columns footings shall be completed first. The column load shall be temporarily removed from the footing by attaching temporary supports to each column. Then the bearing soil beneath the column shall be excavated and replaced with either concrete or an appropriate material. Then the bearing soil beneath the column shall be excavated to a 1:1 line drawn up the near edge of the planned new footing and shall be the same size as the existing footing. The top of the concrete in the underpinning pit shall be ½ to 1 inch below the bottom of the footing. This space shall be filled with non-shrink grout after the underpinning concrete has been set.

G. Utilities

Special considerations should be utilized in the design of the trenches supporting new utilities since the first five feet of the soils consist of miscellaneous materials. Design considerations should include proper backfill for utilities such as the trench excavation to include an additional six inches thick layer of bedding material. The new pipe shall be supported by virgin soil or on the new bedding material.

After the utilities are in place, they can be backfilled with the material excavated from the trench. Wood or pieces of rock or concrete in excess of 3 inches shall be removed from the fill before it is

re-used. Backfill material shall be placed in layers about six inches thick and each layer shall be compacted to 95% of Maximum Modified Density of the fill material.

Temporary construction excavations shall be conducted in accordance with the most recent OSHA guidelines or applicable Federal, State or Local codes.

H. Settlement

It must be noted that no structure or slab should be expected to remain totally free of cracks and minor signs of stress, especially where miscellaneous fill materials were used. Therefore, the flexible nature of structures allows them to respond to movements resulting from minor settlement of fill or natural soils. In addition, products containing cementitious materials also shrink during natural curing. All of the above can induce stresses that result in cosmetic cracking of rigid surfaces. UTIS estimates that the maximum post-construction settlement of new building foundations including pier foundations on the subject property on the order of less than less one quarter of an inch, provided that the recommendations outlined in this report are properly implemented. The differential settlement is estimated to be 0.15 in.

In areas outside the pavement or over excavated areas, the subgrade material shall be removed to a depth of at least six (6) inches and replaced with Recycled Concrete Aggregate (RCA) base material, compacted to at least 95 % of the Modified Proctor Density.

I. Utilities

Special considerations should be utilized in the design of the trenches supporting new utilities since they are buried within the first five feet of these materials. Design considerations should include proper backfill for utilities such as the trench excavation to include an additional six inches thick layer of bedding material. The new pipe shall be supported by virgin soil or on the new bedding material.

After the utilities are in place, they can be backfilled with the material excavated from the trench. Wood or pieces of rock or concrete in excess of 3 inches shall be removed from the fill before it is re-used. Backfill material shall be placed in layers about six inches thick and each layer shall be compacted to 95% of Maximum Modified Density of the fill material.

Temporary construction excavations shall be conducted in accordance with the most recent OSHA guidelines or applicable Federal, State or Local codes.

J. On Site and Stripped Materials

The existing pavement (if encountered) may be recycled by pulverizing the pavement as outlined in the recommendations in controlled and supervised manner and methods. Further, UTIS anticipates that the majority of the on-site soils should be reusable as compacted fill or backfill materials for the intended use including pavement areas, provided that moisture content is controlled within three percent of the optimum value. UTIS recommends that the reuse of on-site materials will be contingent upon careful inspection and evaluation of these materials during the construction phase.

K. Surface Preparation/Proof-Rolling

Prior to placing any fill or sub-base materials for the purpose of raising grades to the desired grades or pavement sub-grade elevations, the existing exposed soils should be compacted to a firm surface by means of several passes in two perpendicular directions using a vibratory drum roller (minimum ten-ton). The surface should then be proof-rolled with a loaded tandem-axle truck in the presence of a qualified geotechnical engineer to assist in identifying soft or loose pockets which may require removal and replacement or further investigation. As necessary, limited over-excavation should be undertaken to address unsatisfactory conditions in the existing material. Any fill or backfill should be placed and compacted in accordance with the recommendations in this report.

L. Sub-Grade Protection and Inspection

Every effort should be made to minimize disturbance of the on-site soils by construction traffic and surface runoff. The surface layers of the sandy soils found on the subject property may require wetting and re-compaction during periods of dry weather. The services of a qualified geotechnical engineer should be retained to inspect soil conditions during construction and verify that the prepared sub-grades for the intended use include pavements to support the intended design loads.

M. Compaction and Placement Requirements

Acceptable fill and backfill should be placed in maximum nine-inch loose lifts and compacted to 95 percent of the maximum dry density within three percent of the optimum moisture content, as determined by ASTM-1557 (Modified Proctor). UTIS recommends using a vibratory drum roller (minimum ten-ton) to compact subgrade fill and natural soils beneath pavements and slabs. A small, hand-held vibratory compactor shall be used within excavations for foundations and around utilities.

N. Surface Runoff Control

Every effort must be made to maintain drainage of surface water away from construction areas, using grading and limiting the exposure of excavations to rainfall. A gravity-fed sump pump should be sufficient for minor, temporary dewatering of any trapped water or surface water encountered during construction. Over-excavation of saturated soils and replacement with controlled structural fill may be required prior to resuming work on disturbed sub-grade soils.

O. Construction Monitoring

The conditions disclosed by the soil borings indicate, on a preliminary basis, that the existing material encountered within the borings would be suitable to support the intended use including pavements. However, a potential risk of variability exists in the site soils. Because conventional auger techniques and split spoon sampling only reveal a limited section of the subsurface material at selected points, UTIS recommends confirming the apparently adequate condition of the fill by means of test pit excavation which would expose a larger cross section and enable a further evaluation of the possible presence of voids, uncontrolled conditions, or deleterious materials (e.g., organic

matter). If unsuitable conditions are encountered at that time, contingency actions, possibly including limited over-excavation of the unsuitable material, may be required.

A qualified *and Accredited Special Inspection Agency* should perform inspection, testing and consultation during construction, as described in this report. Monitoring and testing should also be performed to verify that suitable materials are used for controlled fill and that they are properly placed and compacted over suitable sub-grade soils.

5.0 GENERAL RECOMMENDATIONS AND LIMITATIONS

The recommendations are based on the limited investigations and findings reported by the soil boring contractor. The recommendations are based on the soil conditions encountered on the day of the geotechnical investigation. The conclusions on the recommendations are solely based on the findings presented by the investigation and are location-specific and may not represent the general area of the site. If the conditions encountered during construction vary significantly from those stated in this report, UTIS recommends that it receive immediate notification so that additional investigation can be undertaken, and the recommendations can be amended appropriately.

The recommendations in this report are based on our experience, in conjunction with the limited soils exposed at the site during the field survey. UTIS believes that this information gives an acceptable degree of reliability for anticipating the behavior of the site soils with respect to the proposed improvements. However, UTIS's recommendations are professional opinions, and accuracy cannot be assured beyond the limits of the data obtained in the soil profile. This report is based on the evaluation of the described site and the limited specific anticipated construction. The boring logs and the vertical boring plan are hereby made part of this report.

The soil bearing all the footing shall be surface compacted and installation of all structural fill shall be compacted during the full-time inspection of a qualified soils technician and under controlled conditions to meet the minimum requirements of the design.

The conclusions and recommendations contained in this report are based in part, where noted, upon the data obtained from a limited number of soil borings obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further exploration. If variations or other latent conditions then appear evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

APPENDIX

Test Borings Location Plan

(HQ1) 73 Otis Street, West Babylon, NY 11704
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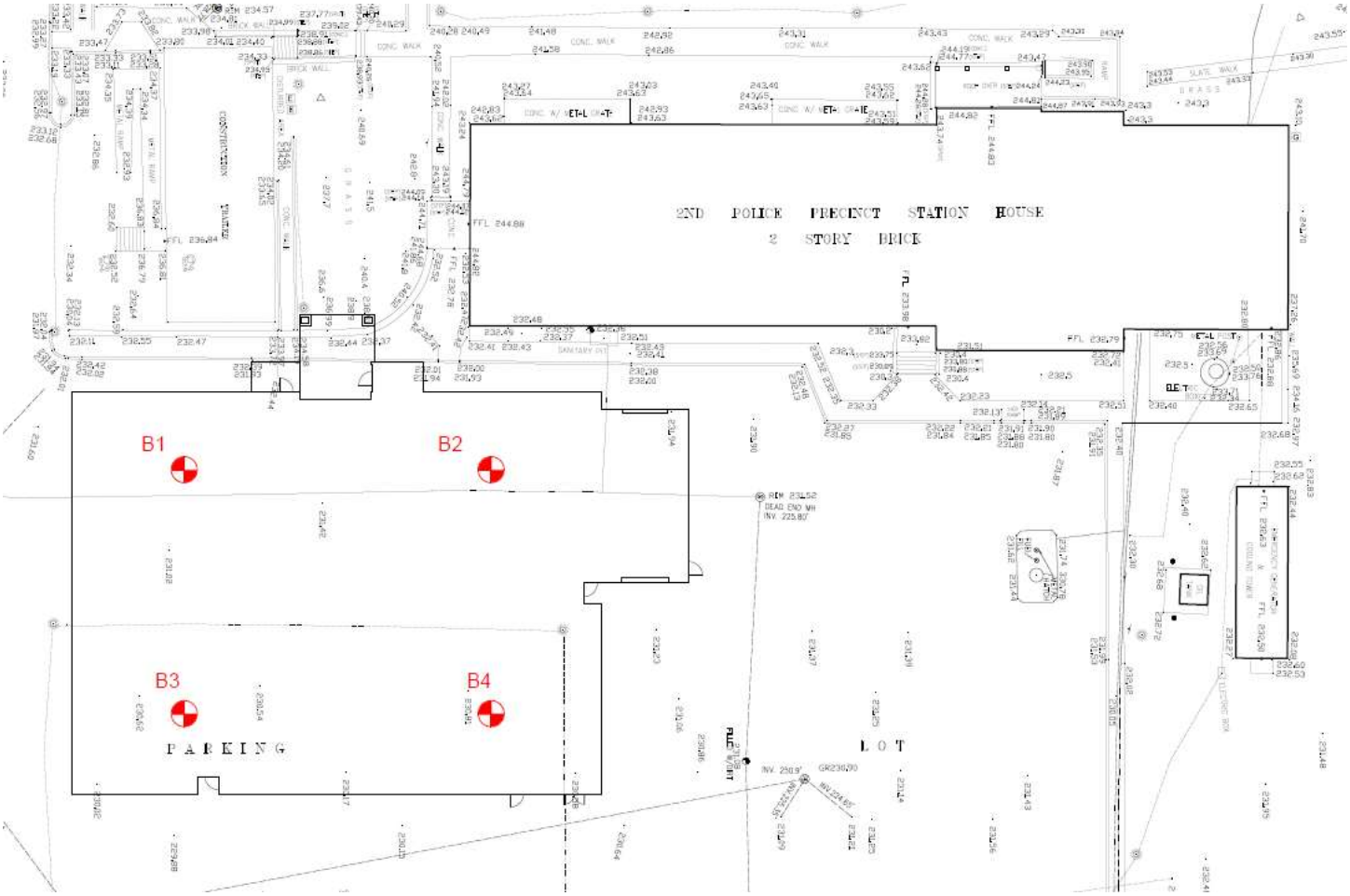
Client	The LiRo Group	**Mobilization Date**	01.10.2023
Developer	N/A	**Completion Date**	01.10.2023
Project	NCPD 2nd Precinct	**Number of Tests**	4 Soil Borings
Job Location	7700 Jericho Turnpike, Westbury	**Method/ Equipment**	CME 45C Truck Mounted Rig and 2018 Ford F550 Support Truck
GC. Representative	N/A	**Weather**	Clear, 40°F
Drilling Crew	R. Morley (Driller) & Joe Kuefner	**Report#**	23-0110D

Location Map:



Boring Log Data

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Scope of Services

(4) Geotechnical Soil Borings

Drilling Activities (Activities Monitored or Sampled)

On January 10th, Universal Drilling & Boring (UDB) mobilized to the referenced project to perform additional full soil test boring to ascertain soil type, classification, groundwater detection and blow counts.

Universal sampled Continuous SPT Samples to pre-determined depths by the client.

At the time of drilling, groundwater was detected at various depths as noted below.

A total of (-109') feet was drilled and (32) SPT Split Spoon Samples.

Method Drilling: ASTM D1586 Standard Test Method for Penetration Test and Split Barrel Sampling of Soil.

Classification of soils was performed utilizing the Unified Soil Classification System and Chapter 18 of the NYS Building Code

Notes:

The Field Representative of Universal Group is on the site solely to observe/identify operations of the contractor(s), observe conformance with contract documentation/specifications and report those daily findings to the client. The presence and activities therein do NOT relieve the contractor(s) obligation to meet contractual, specification and code requirements. The contractor retains sole responsibility for site safety, methods/means, sequences of construction and frequency of inspections, testing, engineering, and general observation therein. This report relates only to the items and/or exact test and/or inspected located and is confidential property of Universal and its client(s). Information contained in this report may not be published or reproduced without written permission from the Universal Group; failure to do so may result in legal obligations on your part. Questions or comments please call us at: 1. 855.UTEST47

UNIVERSAL DRILLING + BORING

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Drilling Crew	R. Morley (Driller) & Joe Kuefner	**Report#**	23-0110D

Depth	Blows Per (6") Inches	Unified Soil Classification and NYC BC Class	N- Value	Soil Sample Description	TB # B - 1
0 - 2 FEET BLG	13-22-26-23	**Misc.**	N/A	Asphalt Pavement, RCA Type Subbase and Brown Fine Sand & Gravel	Sample 1
2 – 4 FEET BLG	13-9-9-5	**SP**	18	Brown Fine Sand & Gravel w/ Trace Silt	Sample 2
4 - 6 FEET BLG	5-5-6-3	**SM**	11	Brown Fine Sand w/ Trace of Silt	Sample 3
6 - 8 FEET BLG	3-5-6-8	**SM**	11	Brown Fine Sand w/ Trace of Silt	Sample 4
8 - 10 FEET BLG	5-6-6-7	**SM**	12	Brown Fine Sand w/ Trace of Silt	Sample 5
15-17 FEET BLG	6-9-12-14	**SM**	21	Brown Fine Sand w/ Trace of Silt	Sample 6
20-22 FEET BLG	6-8-8-7	**SM**	16	Brown Fine Sand w/ Trace of Silt	Sample 7
25-27 FEET BLG	3-5-6-6	**SP**	11	Brown Fine Sand	Sample 8
30-32 FEET BLG	6-10-9-12	**SP**	19	Brown Fine Sand	Sample 9

End of Boring: -32' **Groundwater Encountered at: Not Encountered**

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Drilling Crew	R. Morley (Driller) & Joe Kuefner	**Report#**	23-0110D

Depth	Blows Per (6") Inches	Unified Soil Classification and NYC BC Class	N- Value	Soil Sample Description	TB # B - 2
0 - 2 FEET BLG	22-14-16-20	**Misc.**	N/A	Asphalt Pavement, Stone Subbase and Brown Fine Sand & Gravel	Sample 1
2 – 4 FEET BLG	12-13-11-7	**SP**	24	Brown Fine Sand w/ Gravel	Sample 2
4 - 6 FEET BLG	5-4-3-3	**SP**	7	Brown Fine Sand w/ Gravel	Sample 3
6 - 8 FEET BLG	3-4-5-4	**SP**	9	Brown Fine Sand w/ Gravel	Sample 4
8 - 10 FEET BLG	5-3-4-3	**SP**	7	Brown Fine Sand w/ Gravel	Sample 5
15-17 FEET BLG	6-4-5-7	**SP**	9	Brown Fine Sand w/ Gravel	Sample 6
20-22 FEET BLG	9-6-4-3	**SP**	10	Brown Fine Sand & Gravel w/ Trace Silt	Sample 7
25-27 FEET BLG	9-9-10-10	**SP**	19	Brown Fine Sand & Gravel	Sample 8
30-32 FEET BLG	6-10-10-11	**SP**	20	Brown Fine Sand	Sample 9

End of Boring: -32' **Groundwater Encountered at: Not Encountered**

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Drilling Crew	R. Morley (Driller) & Joe Kuefner	**Report#**	23-0110D

Depth	Blows Per (6") Inches	Unified Soil Classification and NYC BC Class	N- Value	Soil Sample Description	TB # B - 3
0 - 2 FEET BLG	13-16-15-18	**Misc.**	N/A	Asphalt Pavement, Stone Subbase and Brown Fine Sand & Gravel	Sample 1
2 – 4 FEET BLG	9-10-9-10	**SP**	19	Brown Fine Sand w/ Gravel	Sample 2
4 - 6 FEET BLG	9-6-6-9	**GM**	12	Reddish Brown Fine to Medium Sand w/ Gravel and Trace of Silt	Sample 3
6 - 8 FEET BLG	4-7-6-7	**SM / PT**	13	Dark Brown Fine Sand w/ Silt and Trace Organics	Sample 4
8 - 10 FEET BLG	5-4-3-5	**SP**	7	Dark Brown Fine to Medium Sand w/ Gravel	Sample 5
15-17 FEET BLG	15-19-16-18	**SP**	35	Brown Fine Sand w/ Gravel	Sample 6
20-22 FEET BLG	50 for 4"	**SP**	50+	Brown Fine to Medium Sand w/ Large Gravel (Encountered Refusal)	Sample 7

End of Boring: -23' **Groundwater Encountered at: Not Encountered**

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Depth	Blows Per (6") Inches	Unified Soil Classification and NYC BC Class	N- Value	Soil Sample Description	TB # B - 4
0 - 2 FEET BLG	50 for 5" 15-50+	**Misc.**	N/A	Asphalt Pavement, Stone Subbase, Brown Fine Sand w/ Trace of Debris	Sample 1
2 – 4 FEET BLG	15-16-16-14	**SP**	32	Brown Fine Sand w/ Silt and Some Gravel and Trace of Concrete Debris	Sample 2
4 - 6 FEET BLG	6-7-7-4	**GM**	14	Grey Fine Sand w/ Silt and Some Gravel	Sample 3
6 - 8 FEET BLG	3-4-4-3	**PT**	8	Dark Brown Organic Soil w/ Trace of Silt	Sample 4
8 - 10 FEET BLG	2-3-2-4	**CL**	5	Brown Inorganic Clay	Sample 5
15-17 FEET BLG	6-9-9-10	**SP**	18	Brown Fine Sand w/ Some Gravel	Sample 6
20-22 FEET BLG	9-3-7-8	**SP**	10	Brown Fine Sand w/ Some Gravel	Sample 7

End of Boring: -22' **Groundwater Encountered at: Not Encountered**

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Unified Soil Classification System

Major Divisions			Letter	Symbol	Description
Coarse-grained Soils More than ½ retained on the No. 200 Sieve	Gravels More than ½ coarse fraction retained on the No. 4 sieve	Clean Gravels	GW		Well-graded gravels and gravel-sand mixtures, little or no fines.
			GP		Poorly-graded gravels and gravel-sand mixtures, little or no fines.
		Gravels With Fines	GM		Silty gravels, gravel-sand-silt mixtures.
			GC		Clayey gravels, gravel-sand-clay mixtures.
	Sands More than ½ passing through the No. 4 sieve	Clean Sands	SW		Well-graded sands and gravelly sands, little or no fines.
			SP		Poorly-graded sands and gravelly sands, little or no fines.
		Sands With Fines	SM		Silty sands, sand-silt mixtures
			SC		Clayey sands, sandy-clay mixtures.
Fine-grained Soils More than ½ passing through the No. 200 Sieve	Silts and Clays Liquid Limit less than 50%		ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL		Organic clays of medium to high plasticity.
	Silts and Clays Liquid Limit greater than 50%		MH		Inorganic silts, micaceous or diatomaceous fines sands or silts, elastic silts.
			CH		Inorganic clays of high plasticity, fat clays.
			OH		Organic clays of medium to high plasticity.
Highly Organic Soils			PT		Peat, muck, and other highly organic soils.

Consistency Classification

Granular Soils			*Cohesive Soils*		
Description - Blows Per Foot (Corrected)			Description - Blows Per Foot (Corrected)		
	MCS	SPT		MCS	SPT
Very loose	<5	<4	Very soft	<3	<2
Loose	5 - 15	4 - 10	Soft	3 - 5	2 - 4
Medium dense	16 - 40	11 - 30	Firm	6 - 10	5 - 8
Dense	41 - 65	31 - 50	Stiff	11 - 20	9 - 15
Very dense	>65	>50	Very Stiff	21 - 40	16 - 30
			Hard	>40	>30

MCS = Modified California Sampler — SPT = Standard Penetration Test Sampler

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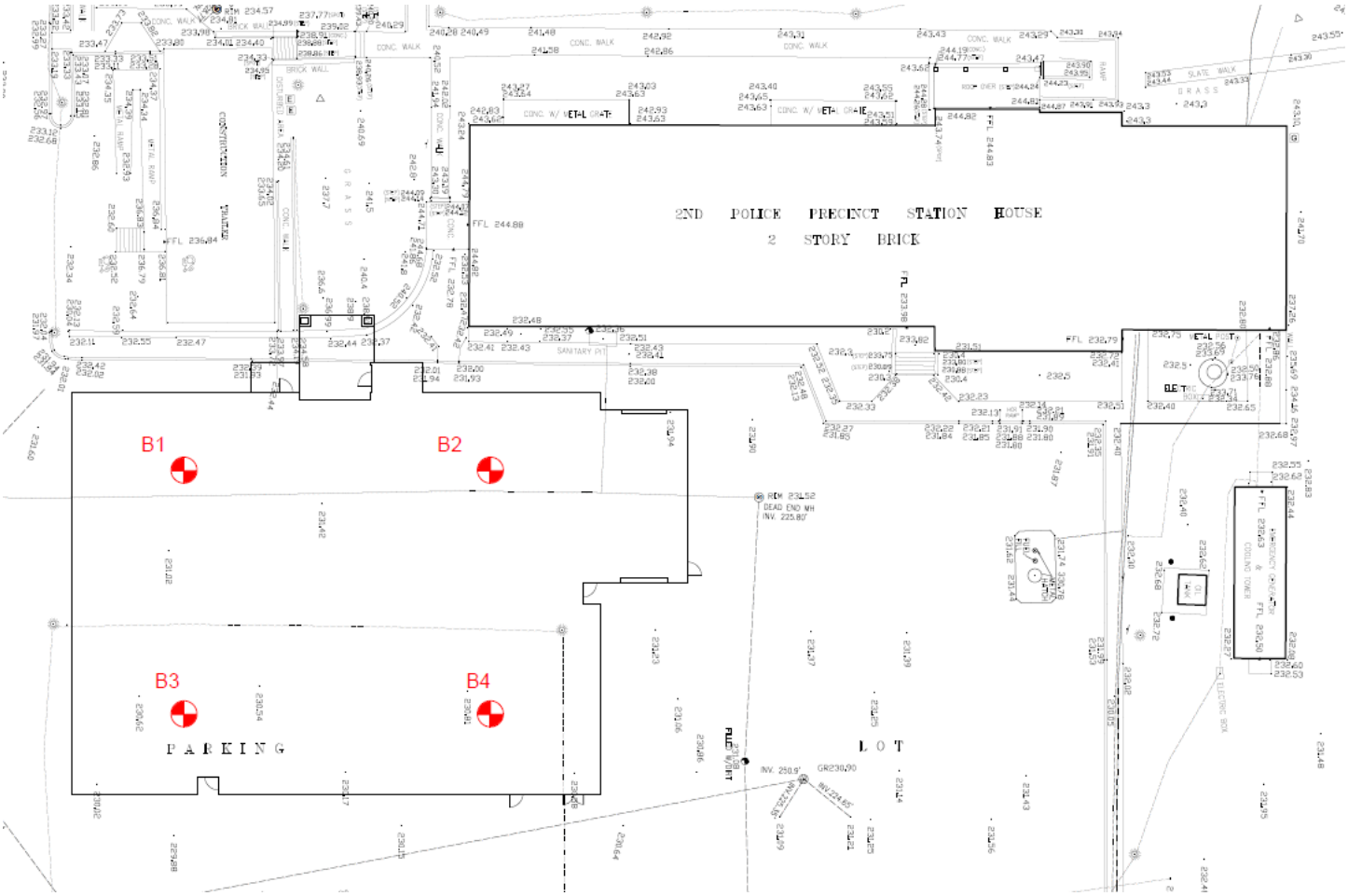
Location Map:



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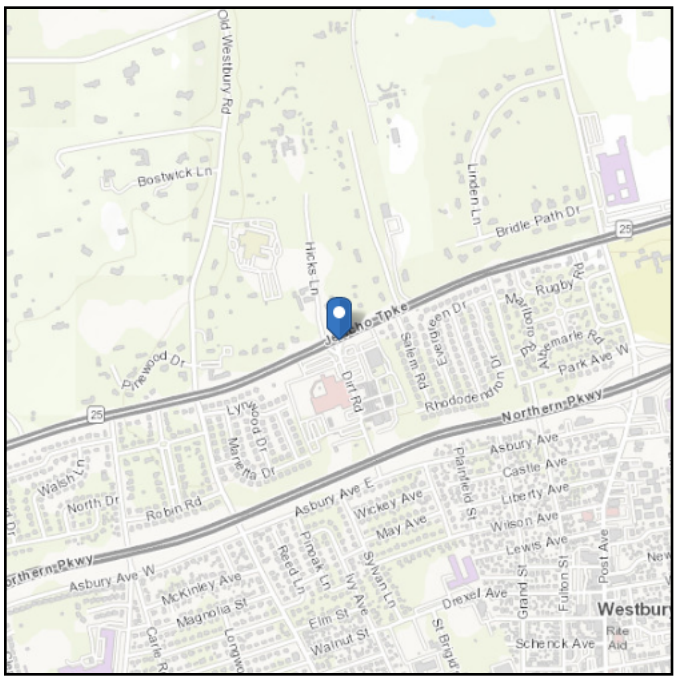
Project Photo

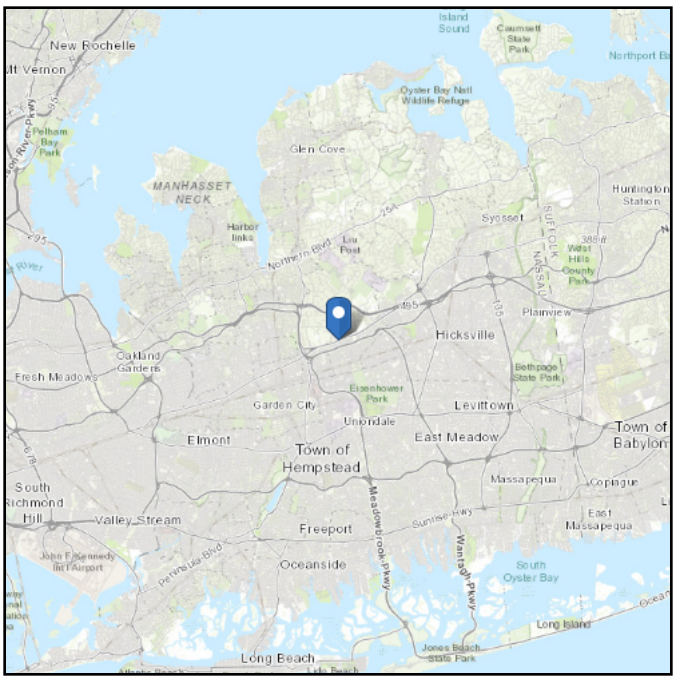
Seismic Design Coefficients

ASCE 7 Hazards Report

Address:
Jericho Tpke
Westbury, New York
11590

Standard:	ASCE/SEI 7-22	**Latitude:**	40.76461
Risk Category:	II	**Longitude:**	-73.597355
Soil Class:	Default	**Elevation:**	124.7 ft (NAVD 88)





Seismic

Default

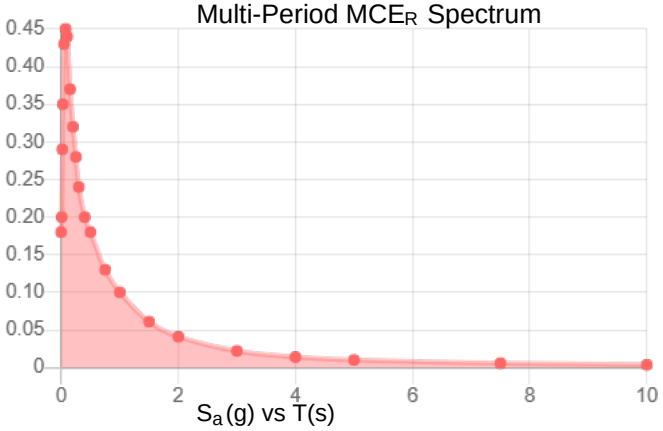
Site Soil Class:

Results:

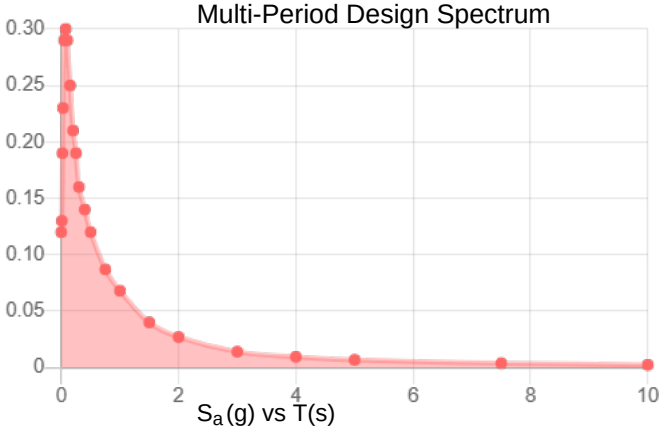
PGA_M :	0.16	T_L :	6
S_{MS} :	0.29	S_S :	0.25
S_{M1} :	0.1	S_1 :	0.048
S_{DS} :	0.19	V_{S30} :	260
S_{D1} :	0.068		

Seismic Design Category: B

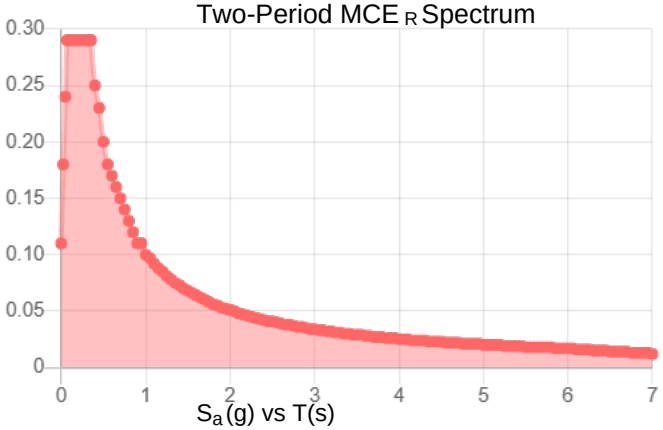
Multi-Period MCE_R Spectrum



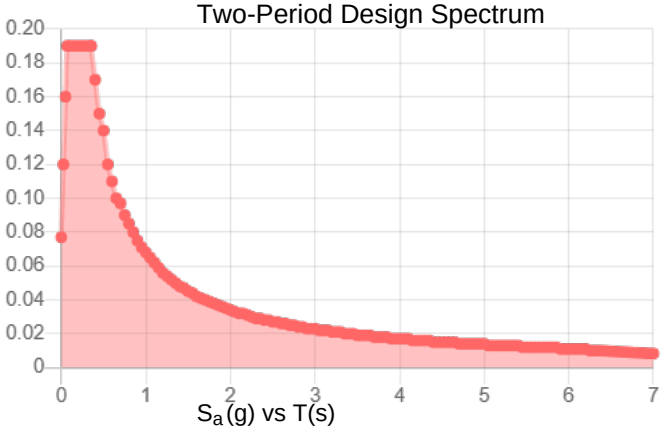
Multi-Period Design Spectrum



Two-Period MCE_R Spectrum



Two-Period Design Spectrum



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Mon Jan 23 2023**

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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J.C. Broderick & Associates, Inc.
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www.jcbroderick.com

December 22, 2022

Mr. Rob Exner
Nassau County Department of Public Works
1194 Prospect Avenue
Westbury New York 11590

Re: Pre-Construction Survey, Bulk Sampling & Analysis of Suspect Asbestos Containing Materials at Nassau County 2nd Police Precinct 7700 Jericho Turnpike, Woodbury, New York,11797 Sampling Date: November 28, 2022, and December 7, 21, 2022

JCB#: 22-53344

Dear Mr. Exner:

J.C. Broderick & Associates, Inc. (JCB) performed bulk sampling and analysis of suspect asbestos containing materials (ACM) that may be disturbed by the following proposed scope of work. The proposed scope of work was identified by the county's representative and was understood by JCB to be limited to the following:

Scope of Work:

- Demolition of existing structure.

Additional testing will be required if the scope of work changes or is different than reported above.

Inspection:

The inspection and subsequent bulk sampling were conducted by a New York State Department of Labor (NYS DOL) Licensed Consulting Firm by a certified asbestos inspector. The suspect materials identified were classified into homogenous material areas and then representative sampling of these materials was performed in accordance with the United States Environmental Protection Agency (US EPA) 40 CFR Part 763.86 (AHERA). Copies of JCB's license and certification information are included in the attachment of this report.

Chain of custody forms were prepared for the samples collected. The samples were delivered to EMSL Analytical Laboratories, Inc. (EMSL) for analysis. EMSL is an independent environmental laboratory accredited by the New York State Department of Health, Environmental Laboratory Approval Program and the United States Department of Commerce, National Voluntary Laboratory Approval Program. Copies of EMSL's certifications are included in the attachment of this report. Technical information regarding the methods of analysis is available upon request.

NYS DOL Industrial Code Rule 56-2.1(p) (ICR 56) and US EPA 40 CFR Part 763.8 (AHERA) define an asbestos containing material (ACM) as any material or product which contains more

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than one percent (1%) of asbestos. In accordance with this definition, the table below summarizes the results of the laboratory analysis reported by EMSL.

Table. 1.0 Suspect Asbestos Containing Building Materials			
ID	**Material Description**	**Scope of Work Location**	**Asbestos**
Confirmed ACBM Expected to be Impacted by the Proposed Scope of Work			
A	**12x12 Floor Tile & Mastic**	**Throughout Building (See Drawing)**	**ASBESTOS**
B	**2nd Layer of Floor Tile & Mastic**	**Throughout Building (See Drawing)**	**ASBESTOS**
C	**Interior & Exterior Window Caulking and Glazing**	**Throughout Building (See Drawing)**	**ASBESTOS**
D	**Mud Joint Packing**	**Throughout Building (Concealed within wall & ceiling plenums)**	**ASBESTOS**
E	**Boiler Breeching, Cementitious**	**Boiler Room**	**ASBESTOS**
F	**Exterior Door Caulking**	**See Drawing (Exterior of Building)**	**ASBESTOS**
G	**Black Waterproofing Tar on Face Brick**	**At Building Cavity behind Face Brick**	**ASBESTOS**
Assumed Present ACBM Expected/Potential to be Impacted by Proposed Scope of Work (Inaccessible for sampling without significant damage to building/materials)			
H	Non-fiberglass Pipe and Pipe Fitting Insulation	Concealed Within Bathroom Wet Walls[1] Casework, Chases, Plenums, etc.	Assumed Asbestos*
I	Transite Piping	Below Grade	Assumed Asbestos*
J	Ceiling Plenum Debris (TSI, etc.)	Ceiling Plenums Within Scope of Work Areas	Assumed Asbestos*
Non-ACBM Expected/Potential to be Impacted by Proposed Scope of Work			
K	Wall Gypsum Board	Throughout Scope of Work	Not Asbestos
L	Wall Gypsum Board Joint Compound	Throughout Scope of Work	Not Asbestos
M	Cementitious Ceiling Plaster	Throughout Scope of Work	Not Asbestos
N	Smooth Ceiling Plaster	Throughout Scope of Work	Not Asbestos
O	Wall Plaster	Throughout Scope of Work	Not Asbestos
P	Duct Insulation Cloth	Throughout Scope of Work	Not Asbestos
Q	Exterior Brick and Mortar	Throughout Scope of Work	Not Asbestos
R	2x4 Ceiling Tile Fissure Speckled	Throughout Scope of Work	Not Asbestos
S	2x4 Ceiling Tile Speckled	Throughout Scope of Work	Not Asbestos
T	2x4 Ceiling Tile Long Fissure	Throughout Scope of Work	Not Asbestos
U	2x4 Ceiling Tile, Faux 1x1	Throughout Scope of Work	Not Asbestos

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Table. 1.0 Suspect Asbestos Containing Building Materials			
ID	**Material Description**	**Scope of Work Location**	**Asbestos**
V	2x2 Ceiling Tile Fissure	Throughout Scope of Work	Not Asbestos
W	1x1 Ceiling Tile, Speckle	Throughout Scope of Work	Not Asbestos
X	1x1 Ceiling Tile, Deep Fissure	Throughout Scope of Work	Not Asbestos
Y	12x12 Floor Tile Pink and Mastic	Throughout Scope of Work	Not Asbestos
Z	12x12 Floor Tile White and Mastic	Throughout Scope of Work	Not Asbestos
AA	12x12 Floor Tile Brown Mastic	Throughout Scope of Work	Not Asbestos
BB	12x12 Floor Tile Gray	Throughout Scope of Work	Not Asbestos
CC	Carpet Mastic	Throughout Scope of Work	Not Asbestos
DD	Floor Tile, Second Layer	Throughout Scope of Work	Not Asbestos
EE	Cove Base Black and Mastic	Throughout Scope of Work	Not Asbestos
FF	Roof Shingle and Tar Paper	Throughout Scope of Work	Not Asbestos
GG	Terrazzo Floor	Throughout Scope of Work	Not Asbestos
HH	Gray Ceramic Floor Tile Grout and Setting Bed	Throughout Scope of Work	Not Asbestos
II	Gray Ceramic Wall Tile Grout and Glue	Throughout Scope of Work	Not Asbestos
JJ	Pink Ceramic Floor Tile Grout and Setting Bed	Throughout Scope of Work	Not Asbestos
KK	Pink Ceramic Wall Tile Grout and Glue	Throughout Scope of Work	Not Asbestos
LL	White Ceramic Floor Tile Grout and Setting Bed	Throughout Scope of Work	Not Asbestos
MM	White Ceramic Wall Tile Grout and Glue	Throughout Scope of Work	Not Asbestos
NN	Blue Ceramic Floor Tile Grout and Setting Bed	Throughout Scope of Work	Not Asbestos
OO	Blue Ceramic Wall Tile Grout and Glue	Throughout Scope of Work	Not Asbestos

*Materials ASSUMED to be asbestos. It should be confirmed if these materials will be impacted by the proposed work.
[2]Full mastic removal by chemical or abrasive means maybe required in locations where asbestos containing mastic is present and new floor penetrations and/or trenching are proposed.

NOTE: Potential of damaged asbestos pipe insulation within ceiling plenum and potential debris on top of ceiling tile. Caution should be exercised within these areas to not disturb asbestos pipe insulation or any debris. If necessary, any disturbance of suspect asbestos containing material must be conducted by a licensed abatement contractor

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Limitations of Inspection:

Although JCB took great care to identify and sample all suspect asbestos containing materials that may be impacted by the proposed scope of work, areas (spaces) and or suspect building materials may not have been accessible for inspection and/or sampling without causing significant damage to the existing building materials or due to physical access. Such areas and or materials that may not have inspected and or sampled due to these circumstances include, but are not limited to, the following

- Non-fiberglass pipe and pipe fitting insulation in plenum spaces such as ceilings, walls, chases, crawl spaces, etc.
- Suspect Debris within plenum spaces such as ceilings, walls, chases, crawl spaces, etc.
- Plenums above plaster ceilings and behind plaster walls.
- Plenums above spline ceiling tile systems.
- Waterproofing membrane in building cavities and below flooring systems (i.e. slabs, ceramic tile, wood, etc.).
- Mastic behind chalkboards/tack boards/mirrors.
- Electrical wire insulation servicing various equipment (ex. lighting fixtures).
- Flooring materials below existing casework.
- Asbestos heat shield insulation between lighting fixture and ceiling.
- Inaccessible, unknown materials (friable and non-friable) below flooring and roof systems.
- Gasket material associated with mechanical systems and duct work.
- Any suspect debris or presumed contaminated sand (such as within plenums and crawlspaces) is not homogenous and not considered a building material in accordance with ICR 56, therefore it cannot be quantitatively tested for asbestos content.

It is recommended that these materials should be presumed to be present or if possible, access be provided to JCB to inspect these spaces/materials.

Conclusions & Recommendations:

The intent of this asbestos containing materials survey was to sample and analyze only the suspect ACM that will be impacted by the proposed scope of work. This survey was not intended to identify all ACMs associated with the subject building and or the referenced subject spaces. If any other suspect ACM are encountered during the performance of the work, that are not referenced in the attachment of this report, these materials must be assumed as being asbestos containing until sampling and analysis is performed and determined otherwise.

Therefore, the contractor shall be advised that during demolition if any suspicious or suspect asbestos material is encountered during demolition, work shall stop immediately, and the contractor shall notify the architect and the material shall be sampled by the county's environmental consultant for asbestos.

No determination was made by JCB if the materials listed in the table are homogenous throughout the remaining portions of the building. That is, the findings of this inspection are limited to information specifically indicated in the table.

The intent of the table above was to report the building materials that are "asbestos-containing" in accordance with the US EPA and NYS DOL. This report was not intended for compliance with the United States Occupational Safety & Health Administration (OSHA) standards. The contractor is responsible for their own compliance to OSHA and shall refer directly to the

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laboratory reports. All confirmed asbestos containing materials that are not scheduled to be removed should be implemented into an asbestos management plan.

Any disturbance of any confirmed asbestos or assumed asbestos containing materials must be performed by a licensed contractor and certified handlers in accordance with New York State Industrial Code Rule 56 (NYS ICR 56) and 40 CFR Part 763 and all other applicable federal, state, and local regulations. General contractors shall also have properly trained and/or certified workers to work in regulated areas. Regulated areas, include crawl spaces, plenums, fan rooms and boiler rooms and any other area where damaged ACM exists or areas where ACM is likely to be disturbed.

It is recommended the architect consider including an additional allowance for asbestos abatement work. The allowance shall be used to cover the cost of asbestos abatement work resulting from unforeseen conditions discovered during demolition and beyond the scope of the contract documents.

All contractors are responsible for the proper handling, staging and disposal of all hazardous and regulated wastes generated because of the work being performed.

The following project information has been included in the attachments section of this report.

1. Drawings & Photologs
2. Chain of Custody and Laboratory Analysis
3. Laboratory Certifications
4. JCB Certifications

If there are any questions or if more information is needed, please feel free to call.

Sincerely,
Paul J. Fazio
Paul J. Fazio
J.C. BRODERICK & ASSOCIATES, INC.

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Drawings & Photologs

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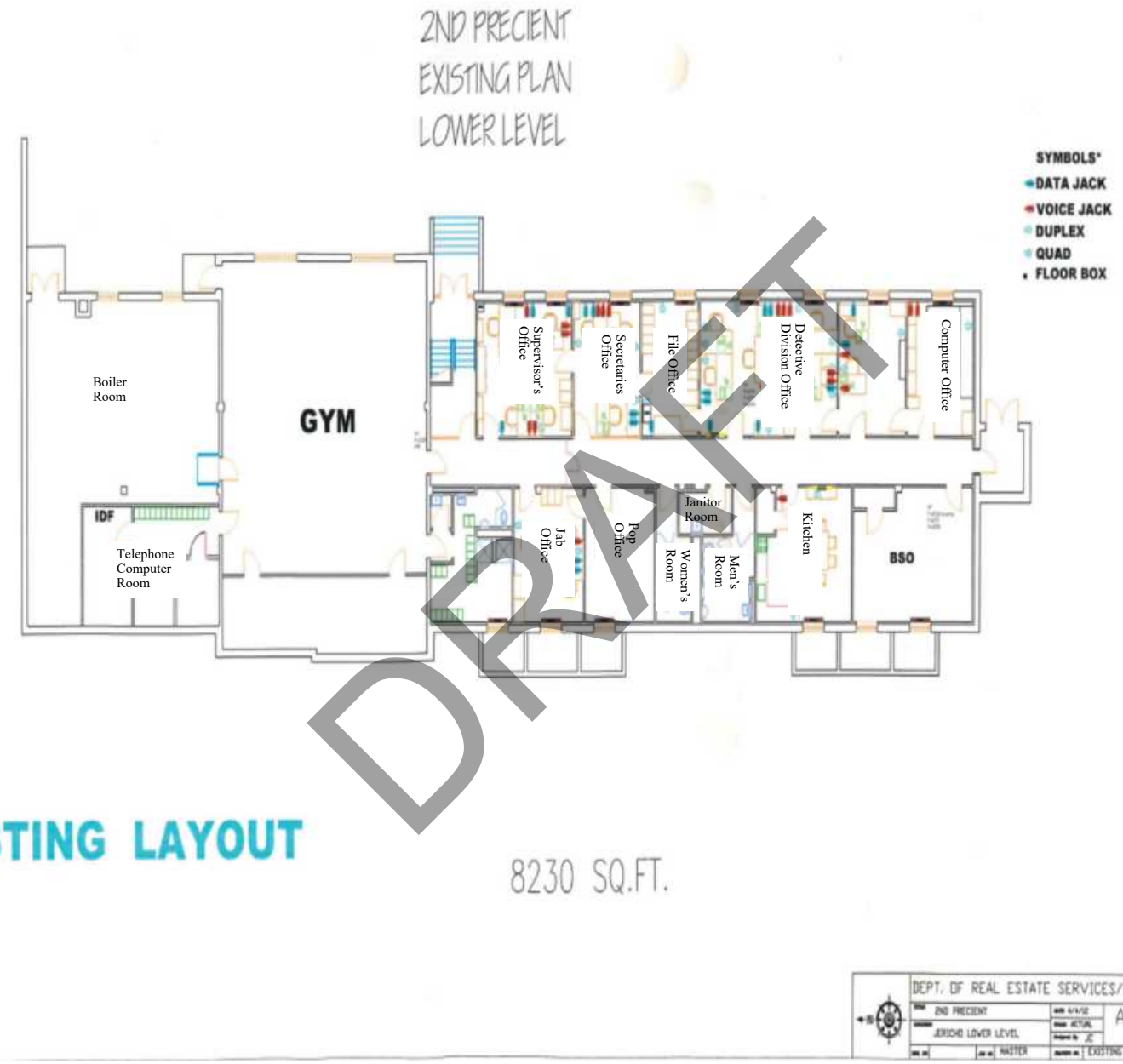
631.584.5492 fax 631.584.3395



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1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

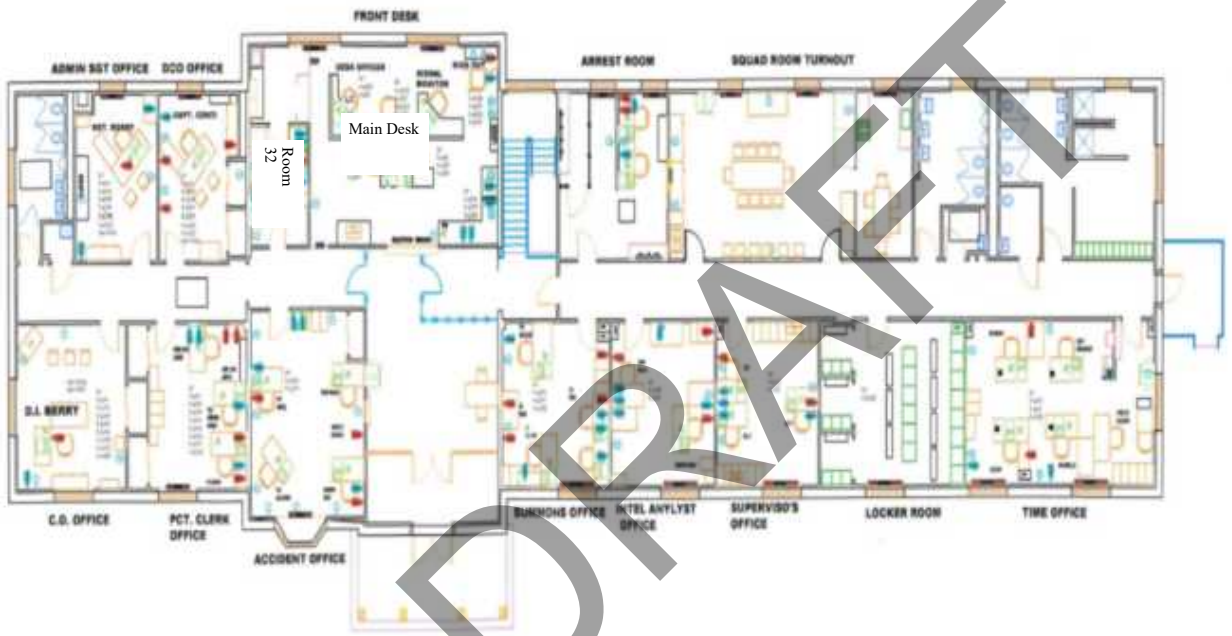
Project No:
22-53344

Building Name:
2nd Police Precinct

Scope of Work Locations

2ND PRECIENT
EXISTING PLAN
1ST FLOOR

SYMBOLS*
- DATA JACK
- VOICE JACK
- DUPLEX
- QUAD
- FLOOR BOX



8230 SQ.FT.

EXISTING LAYOUT

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Scope of Work Locations

Table. 1.0 Suspect Asbestos Containing Building Materials			
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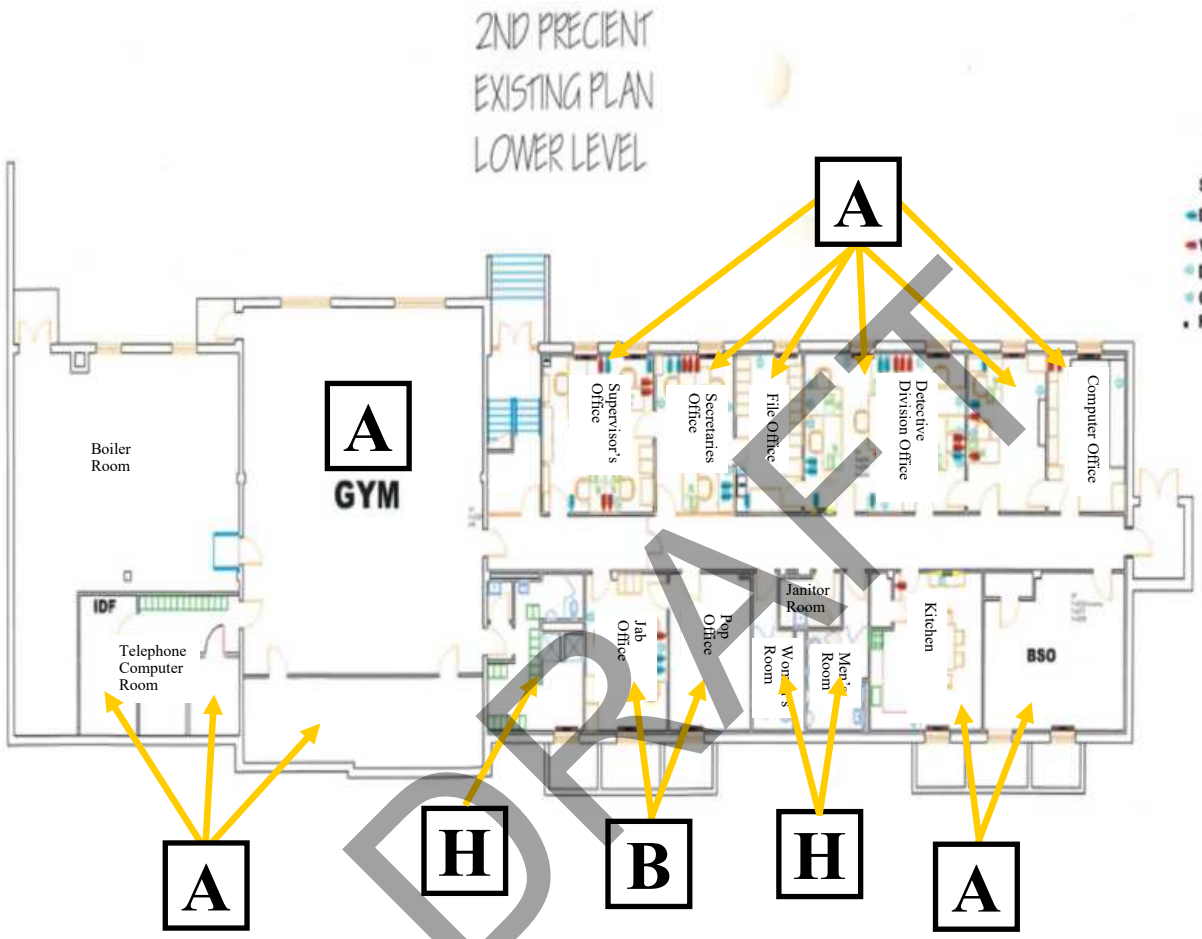
Asbestos Containing Materials Key



Areas of Concern: The contractor is advised that the asbestos containing mud joint packing (pipe elbows) are assumed to exist in plenums and pipe chases. The contractor shall investigate these areas to determine of the material exists and abate if the material is present.

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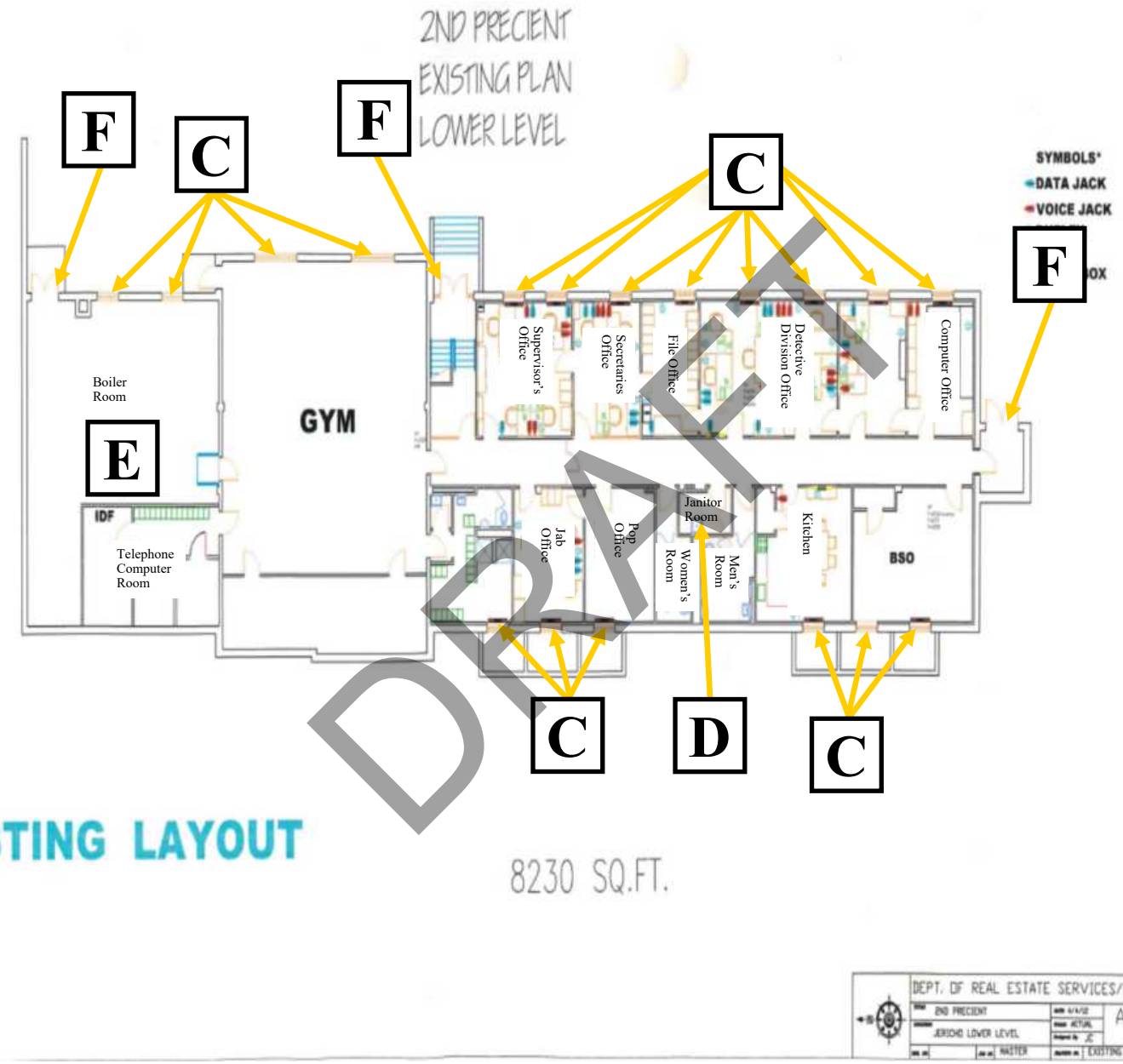
Asbestos Containing Materials



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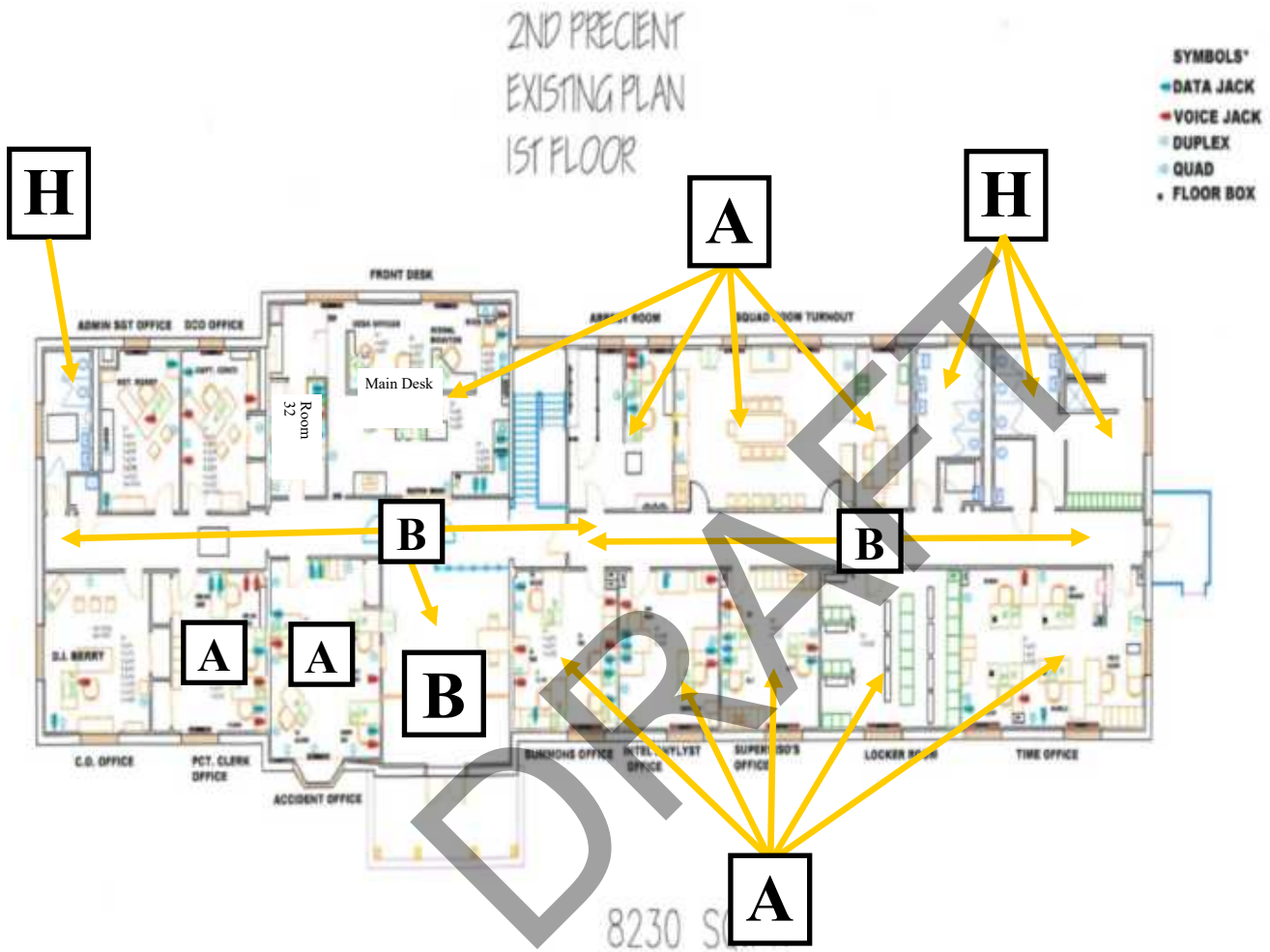

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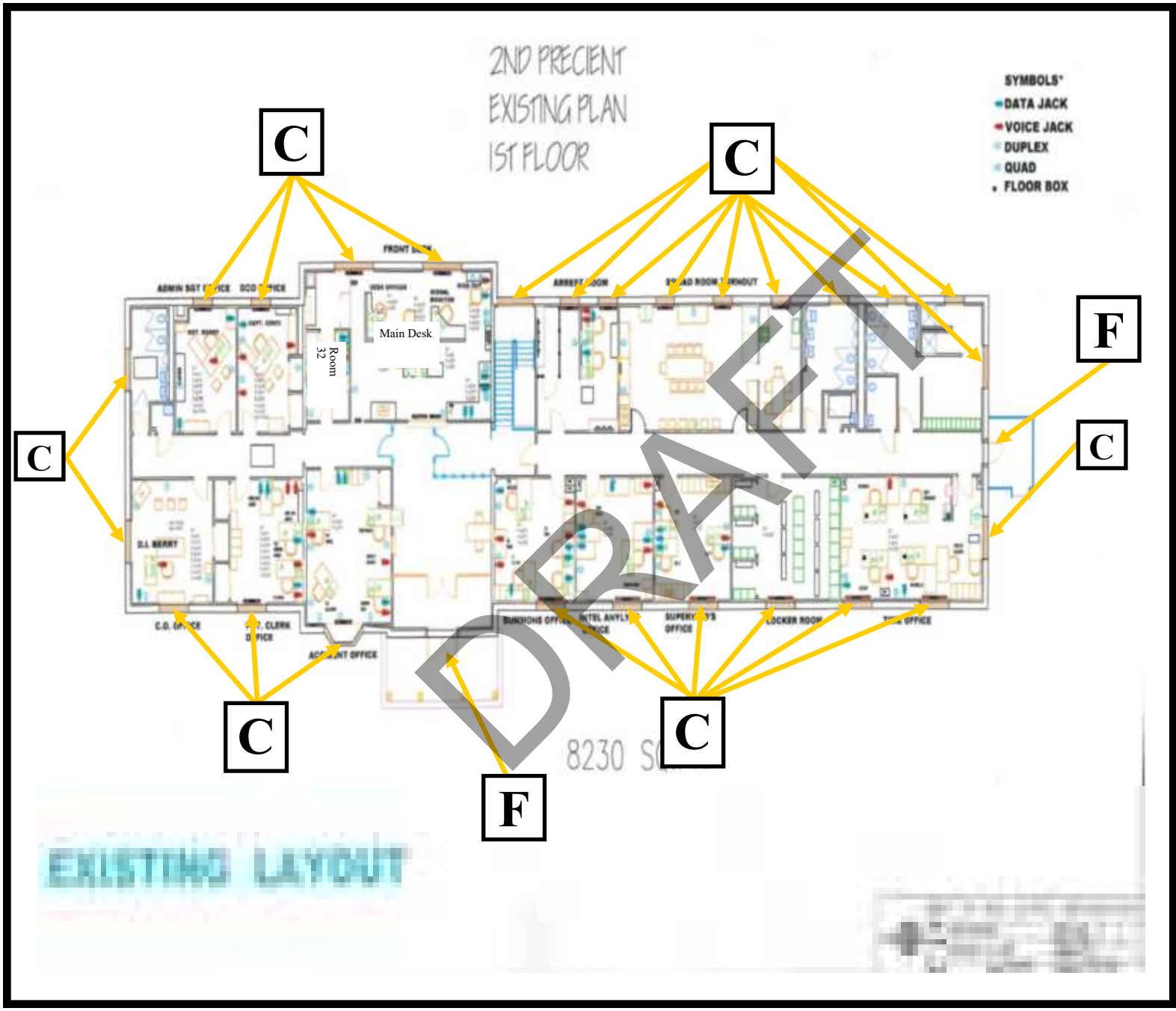

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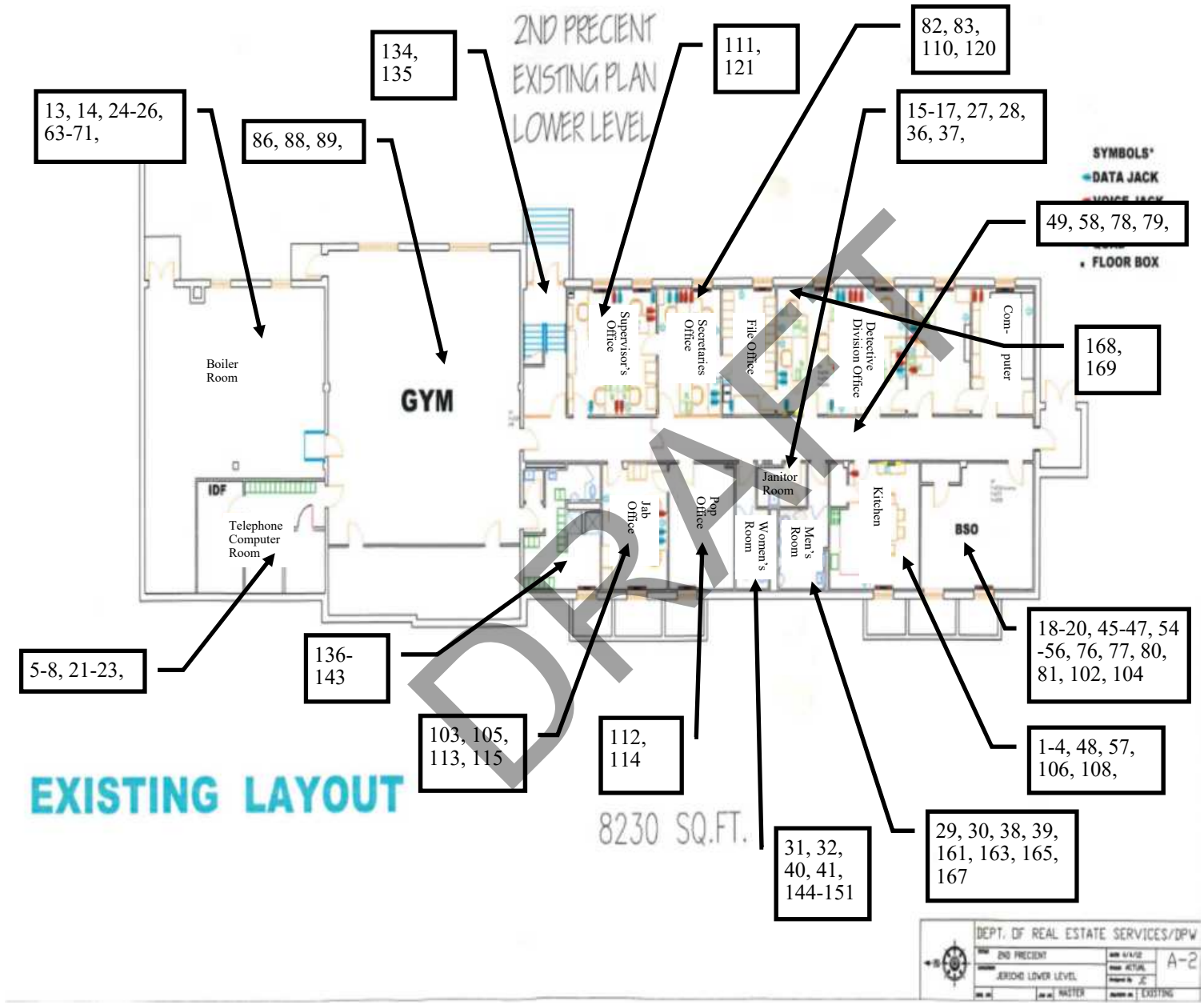

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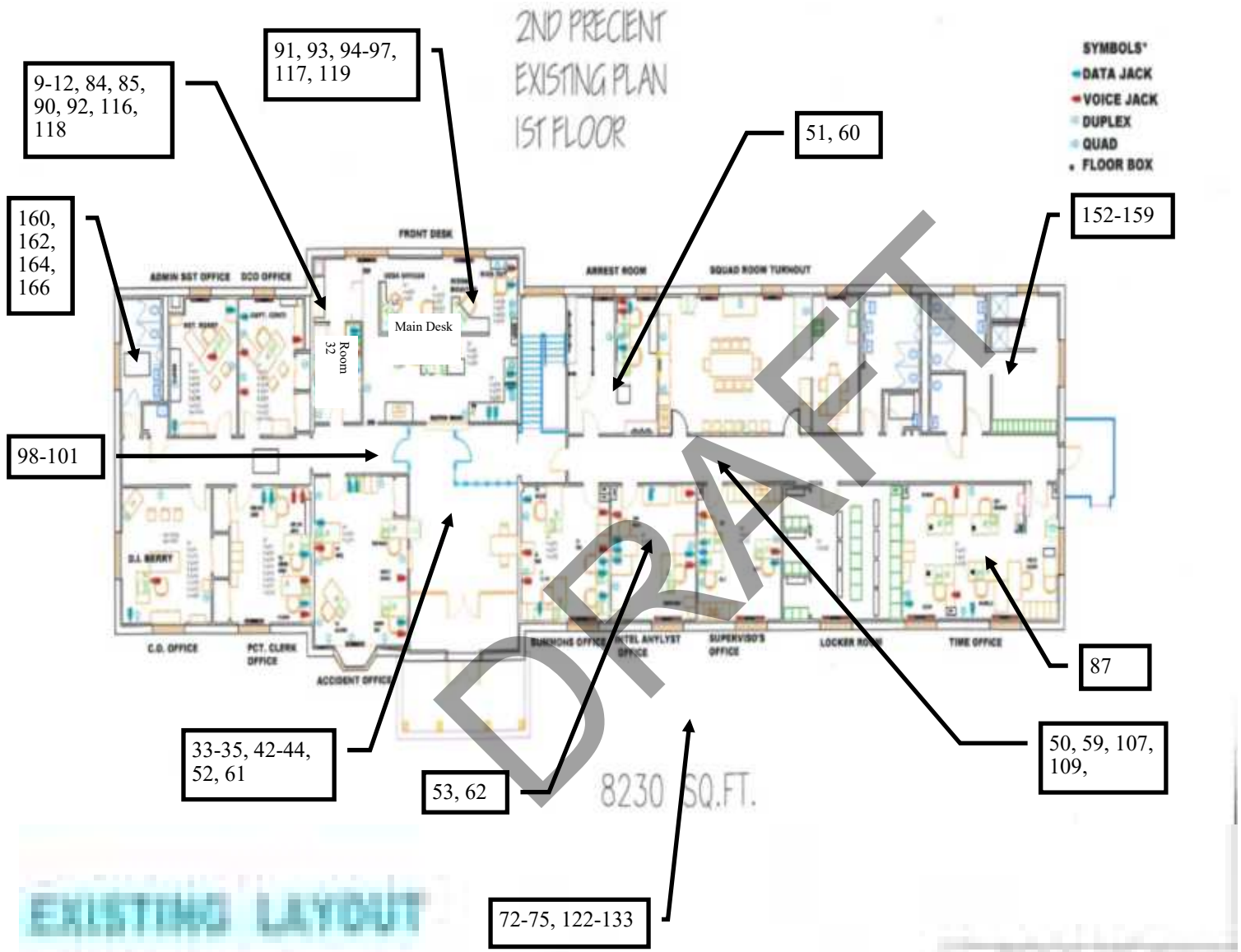
Building Name: 2nd Police Precinct

Sample Locations



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Sample Locations

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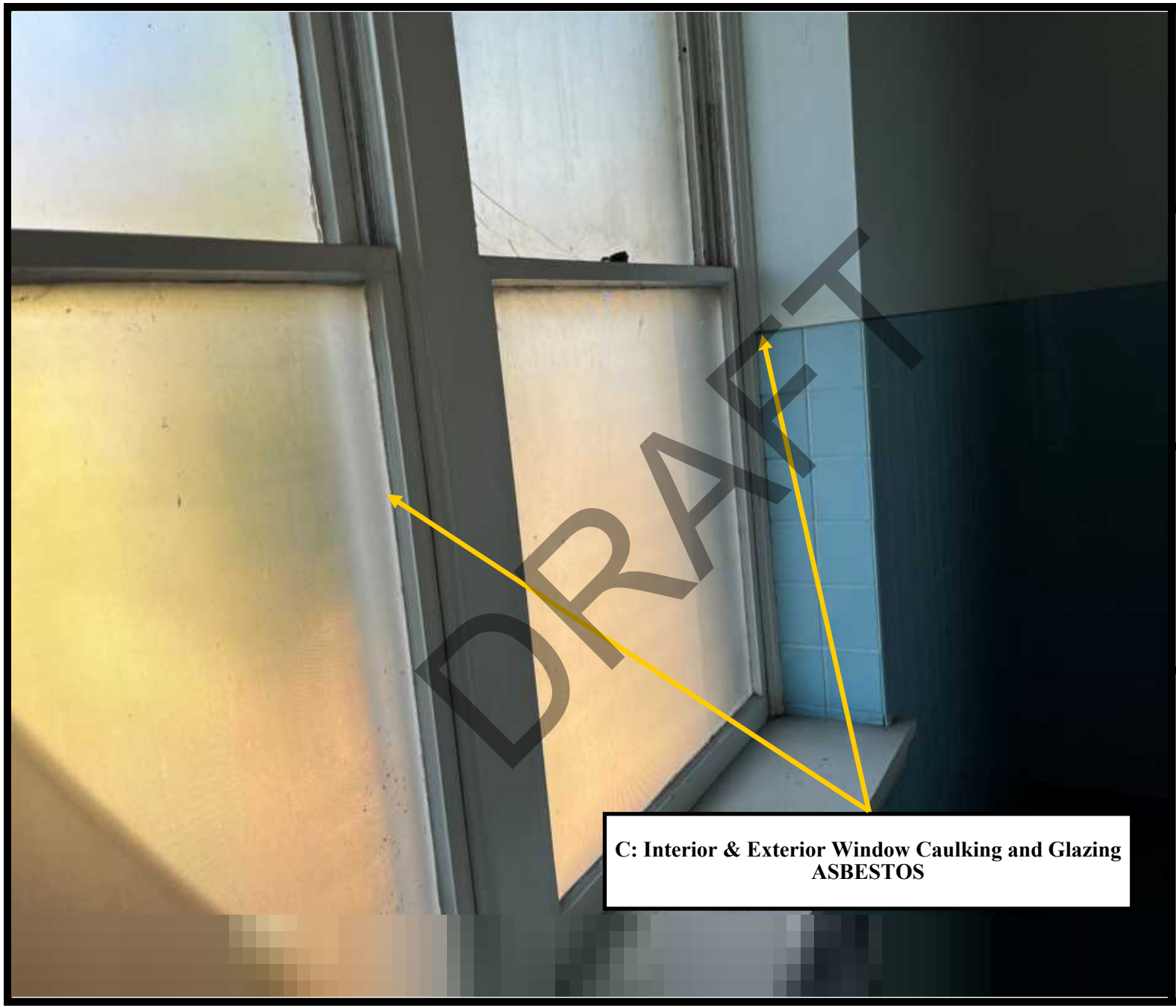
Photo Log



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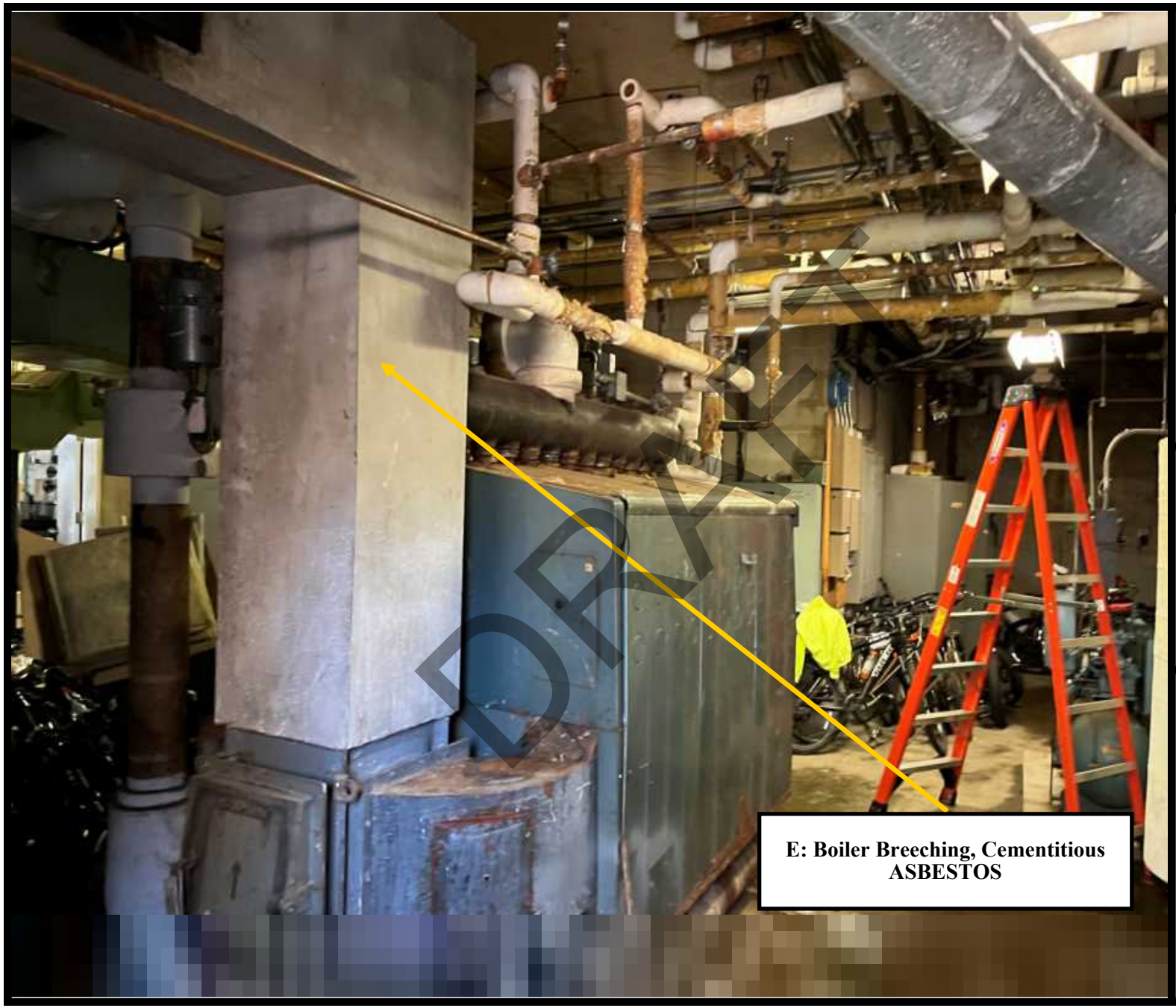

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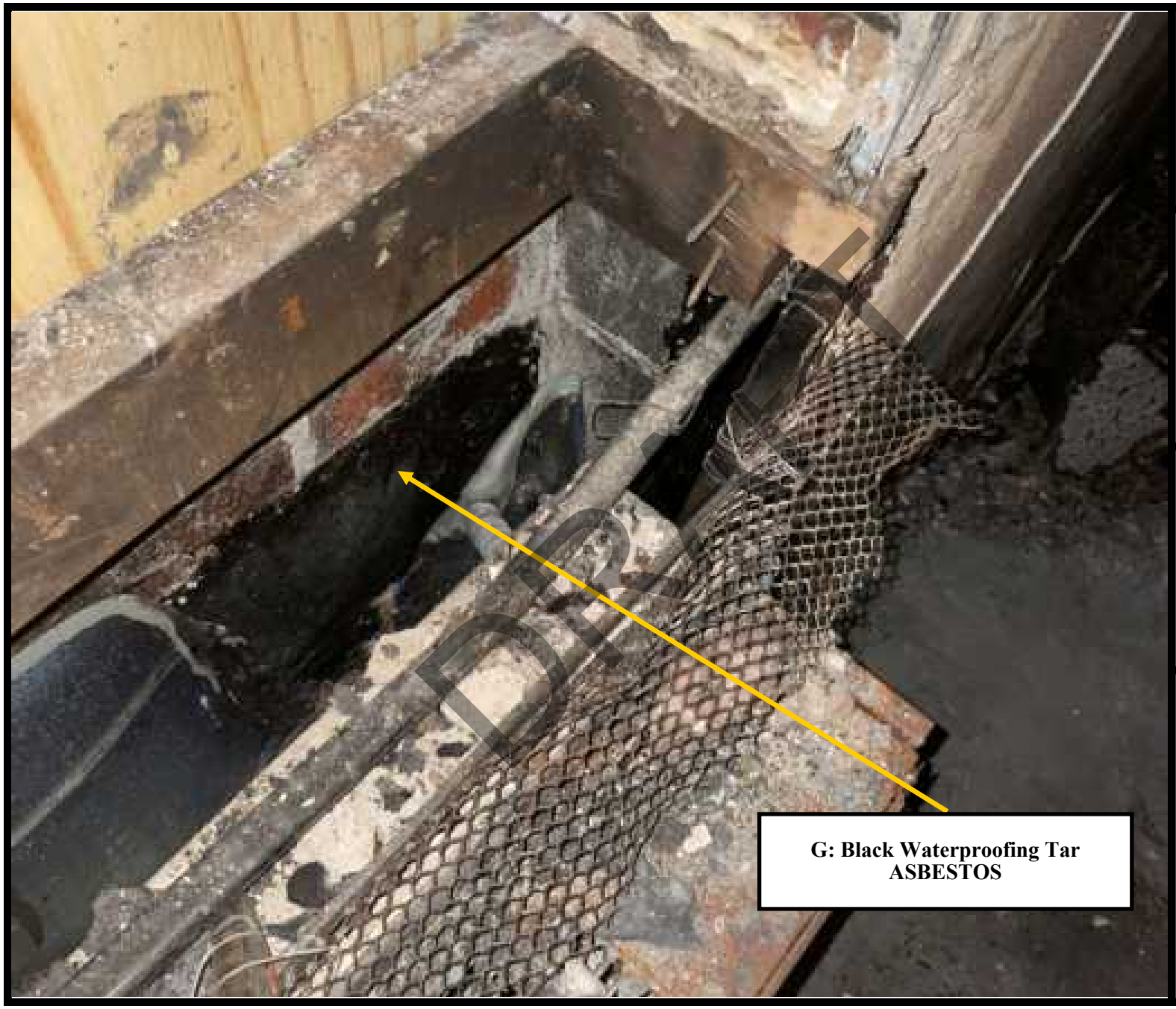

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Photo Log

Chain of Custody
&
Laboratory Analysis

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J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

BULK SAMPLING CHAIN OF CUSTODY RECORD 062224585

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | 12 HOUR | (6 HOUR) | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
1	1	Wall Gypsum Board	First Floor Kitchen	ASB
2	1	Wall Gypsum Board	First Floor Kitchen	ASB
3	2	Wall Gypsum Board Joint Compound	First Floor Kitchen	ASB
4	2	Wall Gypsum Board Joint Compound	First Floor Kitchen	ASB
5	3	Wall Gypsum Board	First Floor Telephone Computer Room	ASB
6	3	Wall Gypsum Board	First Floor Telephone Computer Room	ASB
7	4	Wall Gypsum Board Joint Compound	First Floor Telephone Computer Room	ASB
8	4	Wall Gypsum Board Joint Compound	First Floor Telephone Computer Room	ASB
9	5	Wall Gypsum Board	Second Floor 32 Room	ASB
10	5	Wall Gypsum Board	Second Floor 32 Room	ASB
11	6	Wall Gypsum Board Joint Compound	Second Floor 32 Room	ASB
12	6	Wall Gypsum Board Joint Compound	Second Floor 32 Room	ASB
13	7	Vibration Reducing Cloth, Green	First Floor Boiler Room	ASB
14	7	Vibration Reducing Cloth, Green	First Floor Boiler Room	ASB
15	8	Mud Joint Packing	First Floor Janitor Room	ASB
16	8	Mud Joint Packing	First Floor Janitor Room	ASB
17	8	Mud Joint Packing	First Floor Janitor Room	ASB
18	9	Cementitious Ceiling Plaster	First Floor BSO Office	ASB
19	9	Cementitious Ceiling Plaster	First Floor BSO Office	ASB

2022 NOV 28 P 5:04 CARLE PLACE, NY

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SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao	S.	11.28.22	14.29	Alex Wasch		11/28/22	5:04PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Sawyer Fries	Sawyer Fries	11/28/22	

11/29/22

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

11/30/22 12:37pm

OrderID: 062224585

062224585

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME: (CIRCLE ONE) 24 HOUR | 12 HOUR | (6 HOUR) | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
20	9	Cementitious Ceiling Plaster	First Floor BSO Office	ASB
21	9	Cementitious Ceiling Plaster	First Floor Telephone Computer Room	ASB
22	9	Cementitious Ceiling Plaster	First Floor Telephone Computer Room	ASB
23	9	Cementitious Ceiling Plaster	First Floor Telephone Computer Room	ASB
24	9	Cementitious Ceiling Plaster	First Floor Boiler Room	ASB
25	9	Cementitious Ceiling Plaster	First Floor Boiler Room	ASB
26	9	Cementitious Ceiling Plaster	First Floor Boiler Room	ASB
27	10	Smooth Ceiling Plaster White Coat	First Floor Janitor Room	ASB
28	10	Smooth Ceiling Plaster White Coat	First Floor Janitor Room	ASB
29	10	Smooth Ceiling Plaster White Coat	First Floor Men's Room	ASB
30	10	Smooth Ceiling Plaster White Coat	First Floor Men's Room	ASB
31	10	Smooth Ceiling Plaster White Coat	First Floor Women's Room	ASB
32	10	Smooth Ceiling Plaster White Coat	First Floor Women's Room	ASB
33	10	Smooth Ceiling Plaster White Coat	Second Floor Main Lobby	ASB
34	10	Smooth Ceiling Plaster White Coat	Second Floor Main Lobby	ASB
35	10	Smooth Ceiling Plaster White Coat	Second Floor Main Lobby	ASB
36	11	Smooth Ceiling Plaster Brown Coat	First Floor Janitor Room	ASB
37	11	Smooth Ceiling Plaster Brown Coat	First Floor Janitor Room	ASB
38	11	Smooth Ceiling Plaster Brown Coat	First Floor Men's Room	ASB

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RECEIVED
2022 NOV 28 P 5:04

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao	S.	11.28.22	14.29	Alex Hoschar		11/28/22	5:04PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Sawyer Fria	Sawyer Fria	11/28/22	

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11/29/22

11/29/22 12:37 pm

OrderID: 062224585

062224585

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | 12 HOUR | (6 HOUR) | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
39	11	Smooth Ceiling Plaster Brown Coat	First Floor Men's Room	ASB
40	11	Smooth Ceiling Plaster Brown Coat	First Floor Women's Room	ASB
41	11	Smooth Ceiling Plaster Brown Coat	First Floor Women's Room	ASB
42	11	Smooth Ceiling Plaster Brown Coat	Second Floor Main Lobby	ASB
43	11	Smooth Ceiling Plaster Brown Coat	Second Floor Main Lobby	ASB
44	11	Smooth Ceiling Plaster Brown Coat	Second Floor Main Lobby	ASB
45	12	Wall Plaster White Coat	First Floor BSO Office	ASB
46	12	Wall Plaster White Coat	First Floor BSO Office	ASB
47	12	Wall Plaster White Coat	First Floor BSO Office	ASB
48	12	Wall Plaster White Coat	First Floor Kitchen	ASB
49	12	Wall Plaster White Coat	First Floor Corridor	ASB
50	12	Wall Plaster White Coat	Second Floor Corridor	ASB
51	12	Wall Plaster White Coat	Second Floor Arrest Room	ASB
52	12	Wall Plaster White Coat	Second Floor Main Lobby	ASB
53	12	Wall Plaster White Coat	Second Floor Crime Analyst	ASB
54	13	Wall Plaster Brown Coat	First Floor BSO Office	ASB
55	13	Wall Plaster Brown Coat	First Floor BSO Office	ASB
56	13	Wall Plaster Brown Coat	First Floor BSO Office	ASB
57	13	Wall Plaster Brown Coat	First Floor Kitchen	ASB

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SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao	S.	11.28.22	14.29	Alex Wechsler		11/28/22	5:04PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Sawyer Fazio	Sawyer Fazio	11/28/22	

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11/29/22

11/29/22 12:37 PM

OrderID: 062224585

BULK SAMPLING CHAIN OF CUSTODY RECORD 062224585

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN:
LABORATORY: EMSL
TURNAROUND TIME: (CIRCLE ONE) 24 HOUR | 12 HOUR | (6 HOUR) | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
58	13	Wall Plaster Brown Coat	First Floor Corridor	ASB
59	13	Wall Plaster Brown Coat	Second Floor Corridor	ASB
60	13	Wall Plaster Brown Coat	Second Floor Arrest Room	ASB
61	13	Wall Plaster Brown Coat	Second Floor Main Lobby	ASB
62	13	Wall Plaster Brown Coat	Second Floor Crime Analyst	ASB
63	14	Internal Boiler Material	First Floor Boiler Room	ASB
64	14	Internal Boiler Material	First Floor Boiler Room	ASB
65	14	Internal Boiler Material	First Floor Boiler Room	ASB
66	15	Duct Insulation, Cementitious	First Floor Boiler Room	ASB
67	15	Duct Insulation, Cementitious	First Floor Boiler Room	ASB
68	15	Duct Insulation, Cementitious	First Floor Boiler Room	ASB
69	16	Duct Insulation Cloth	First Floor Boiler Room	ASB
70	16	Duct Insulation Cloth	First Floor Boiler Room	ASB
71	16	Duct Insulation Cloth	First Floor Boiler Room	ASB
72	17	Exterior Brick	Exterior of Building	ASB
73	17	Exterior Brick	Exterior of Building	ASB
74	18	Exterior Brick Mortar	Exterior of Building	ASB
75	18	Exterior Brick Mortar	Exterior of Building	ASB

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SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao		11.28.22	14.29	Alex Hasch		11/28/22	5:04PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Sawyer Fries		11/28/22	

J.C. BRODERICK & ASSOCIATES

1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

11/29/22 12:37pm

OrderID: 062224585

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1
Hauppauge, NY 11788

Phone: (631) 584-5492
Fax:
Received Date: 11/28/2022 5:04 PM
Analysis Date: 11/28/2022 - 11/29/2022
Collected Date: 11/28/2022

Project: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 1-1		**Description**	First Floor - Kitchen - Wall Gypsum Board		
062224585-0001		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	10.00% Cellulose	72.00% Gypsum 18.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 1-2		**Description**	First Floor - Kitchen - Wall Gypsum Board		
062224585-0002		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	11.00% Cellulose	71.00% Gypsum 18.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 2-3		**Description**	First Floor - Kitchen - Wall Gypsum Board Joint Compound		
062224585-0003		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		80.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 2-4		**Description**	First Floor - Kitchen - Wall Gypsum Board Joint Compound		
062224585-0004		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		84.00% Ca Carbonate 4.00% Mica 12.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

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Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 3-5		**Description**	First Floor - Telephone Computer Room - Wall Gypsum Board		
062224585-0005		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	13.00% Cellulose	71.00% Gypsum 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 3-6		**Description**	First Floor - Telephone Computer Room - Wall Gypsum Board		
062224585-0006		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	12.00% Cellulose	72.00% Gypsum 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 4-7		**Description**	First Floor - Telephone Computer Room - Wall Gypsum Board Joint Compound		
062224585-0007		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		80.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 4-8		**Description**	First Floor - Telephone Computer Room - Wall Gypsum Board Joint Compound		
062224585-0008		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		83.00% Ca Carbonate 4.00% Mica 13.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 5-9		**Description**	Second Floor - 32 Room - Wall Gypsum Board		
062224585-0009		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	12.00% Cellulose	72.00% Gypsum 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 5-10		**Description**	Second Floor - 32 Room - Wall Gypsum Board		
062224585-0010		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown/ White	10.00% Cellulose	70.00% Gypsum 20.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

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528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 6-11		**Description**	Second Floor - 32 Room - Wall Gypsum Board Joint Compound		
062224585-0011		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		80.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 6-12		**Description**	Second Floor - 32 Room - Wall Gypsum Board Joint Compound		
062224585-0012		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	White		82.00% Ca Carbonate 4.00% Mica 14.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 7-13		**Description**	First Floor - Boiler Room - Vibration Reducing Cloth - Green		
062224585-0013		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Black	95.00% Cellulose	5.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 7-14		**Description**	First Floor - Boiler Room - Vibration Reducing Cloth - Green		
062224585-0014		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Black	94.00% Cellulose	6.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 8-15		**Description**	First Floor - Janitor Room - Mud Joint Packing		
062224585-0015		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown	15.00% Min. Wool	25.00% Ca Carbonate 30.00% Gypsum 16.00% Non-fibrous (other)	**14.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 8-16		**Description**	First Floor - Janitor Room - Mud Joint Packing		
062224585-0016		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	11/28/2022	Brown	13.00% Min. Wool	25.00% Ca Carbonate 30.00% Gypsum 18.00% Non-fibrous (other)	**14.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 8-17 *062224585-0017*		**Description** First Floor - Janitor Room - Mud Joint Packing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/28/2022	Tan	12.00% Min. Wool	30.00% Ca Carbonate 32.00% Gypsum 13.00% Non-fibrous (other)	**13.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 9-18 *062224585-0018*		**Description** First Floor - BSO Office - Cementitious Ceiling Plaster **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00% Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.					
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 9-19 *062224585-0019*		**Description** First Floor - BSO Office - Cementitious Ceiling Plaster **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00% Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.					
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 9-20 *062224585-0020*		**Description** First Floor - BSO Office - Cementitious Ceiling Plaster **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00% Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.					
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 9-21 *062224585-0021*		**Description** First Floor - Telephone Computer Room - Cementitious Ceiling Plaster **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00% Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.					
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

EMSL Analytical, Inc.
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous		Asbestos
Sample ID 9-22 *062224585-0022*		**Description**	First Floor - Telephone Computer Room - Cementitious Ceiling Plaster			
		Homogeneity	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00%	Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.						
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 9-23 *062224585-0023*		**Description**	First Floor - Telephone Computer Room - Cementitious Ceiling Plaster			
		Homogeneity	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00%	Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.						
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 9-24 *062224585-0024*		**Description**	First Floor - Boiler Room - Cementitious Ceiling Plaster			
		Homogeneity	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00%	Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.						
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 9-25 *062224585-0025*		**Description**	First Floor - Boiler Room - Cementitious Ceiling Plaster			
		Homogeneity	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00%	Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.						
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 9-26 *062224585-0026*		**Description**	First Floor - Boiler Room - Cementitious Ceiling Plaster			
		Homogeneity	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown	None	100.00%	Non-fibrous (other) Vermiculite Present	
Surfacing Material containing vermiculite. NYS requires ELAP method 198.8.						
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**

DRAFT

Initial report from: 11/29/2022 14:46:38

EMSL Analytical, Inc.
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EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 10-27 *062224585-0027*		**Description** First Floor - Janitor Room - Smooth Ceiling Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		65.00% Ca Carbonate 22.00% Gypsum 13.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-28 *062224585-0028*		**Description** First Floor - Janitor Room - Smooth Ceiling Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		77.00% Ca Carbonate 19.00% Gypsum 4.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-29 *062224585-0029*		**Description** First Floor - Men's Room - Smooth Ceiling Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		59.00% Ca Carbonate 22.00% Gypsum 19.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-30 *062224585-0030*		**Description** First Floor - Men's Room - Smooth Ceiling Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		59.00% Ca Carbonate 27.00% Gypsum 14.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-31 *062224585-0031*		**Description** First Floor - Women's Room - Smooth Ceiling Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		66.00% Ca Carbonate 23.00% Gypsum 11.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 10-32 *062224585-0032*		**Description**	First Floor - Women's Room - Smooth Ceiling Plaster - White Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	White		66.00% Ca Carbonate 26.00% Gypsum 8.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-33 *062224585-0033*		**Description**	Second Floor - Main Lobby - Smooth Ceiling Plaster - White Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	White		65.00% Ca Carbonate 28.00% Gypsum 7.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-34 *062224585-0034*		**Description**	Second Floor - Main Lobby - Smooth Ceiling Plaster - White Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	White		65.00% Ca Carbonate 21.00% Gypsum 14.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-35 *062224585-0035*		**Description**	Second Floor - Main Lobby - Smooth Ceiling Plaster - White Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	White		70.00% Ca Carbonate 19.00% Gypsum 11.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-36 *062224585-0036*		**Description**	First Floor - Janitor Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Brown		26.00% Ca Carbonate 9.00% Non-fibrous (other) 65.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 11-37 *062224585-0037*		**Description**	First Floor - Janitor Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Brown		15.00% Ca Carbonate 15.00% Non-fibrous (other) 70.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-38 *062224585-0038*		**Description**	First Floor - Men's Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Brown		26.00% Ca Carbonate 9.00% Non-fibrous (other) 65.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-39 *062224585-0039*		**Description**	First Floor - Men's Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Tan/ White		12.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-40 *062224585-0040*		**Description**	First Floor - Women's Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Tan		22.00% Ca Carbonate 11.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 51.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-41 *062224585-0041*		**Description**	First Floor - Women's Room - Smooth Ceiling Plaster - Brown Coat		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	11/29/2022	Tan		12.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 11-42 *062224585-0042*		**Description** Second Floor - Main Lobby - Smooth Ceiling Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		22.00% Ca Carbonate 12.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-43 *062224585-0043*		**Description** Second Floor - Main Lobby - Smooth Ceiling Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	3.00% Cellulose	13.00% Ca Carbonate 20.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 48.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-44 *062224585-0044*		**Description** Second Floor - Main Lobby - Smooth Ceiling Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		12.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-45 *062224585-0045*		**Description** First Floor - BSO Office - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	White/ Various		30.00% Ca Carbonate 60.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-46 *062224585-0046*		**Description** First Floor - BSO Office - Wall Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White		25.00% Ca Carbonate 65.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 12-47 *062224585-0047*		**Description** First Floor - BSO Office - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown/ White/ Green	3.00% Cellulose	30.00% Ca Carbonate 55.00% Gypsum 12.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-48 *062224585-0048*		**Description** First Floor - Kitchen - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown/ White/ Green	3.00% Cellulose	27.00% Ca Carbonate 60.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-49 *062224585-0049*		**Description** First Floor - Corridor - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	Brown/ White/ Green		30.00% Ca Carbonate 60.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-50 *062224585-0050*		**Description** Second Floor - Corridor - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	White/ Various		25.00% Ca Carbonate 65.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-51 *062224585-0051*		**Description** Second Floor - Arrest Room - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	White/ Various	3.00% Cellulose	27.00% Ca Carbonate 60.00% Gypsum 10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 12-52 *062224585-0052*		**Description** Second Floor - Main Lobby - Wall Plaster - White Coat **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	White/ Black	3.00% Cellulose	30.00% Ca Carbonate 55.00% Gypsum 12.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-53 *062224585-0053*		**Description** Second Floor - Crime Analyst - Wall Plaster - White Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	White/ Black	3.00% Cellulose	30.00% Ca Carbonate 55.00% Gypsum 12.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-54 *062224585-0054*		**Description** First Floor - BSO Office - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	3.00% Cellulose	12.00% Ca Carbonate 20.00% Gypsum 5.00% Mica 10.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-55 *062224585-0055*		**Description** First Floor - BSO Office - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		14.00% Ca Carbonate 23.00% Gypsum 4.00% Mica 9.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-56 *062224585-0056*		**Description** First Floor - BSO Office - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		14.00% Ca Carbonate 20.00% Gypsum 4.00% Mica 14.00% Non-fibrous (other) 48.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 13-57 *062224585-0057*		**Description** First Floor - Kitchen - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		11.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 13.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-58 *062224585-0058*		**Description** First Floor - Corridor - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		12.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 11.00% Non-fibrous (other) 51.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-59 *062224585-0059*		**Description** Second Floor - Corridor - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		11.00% Ca Carbonate 21.00% Gypsum 4.00% Mica 14.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-60 *062224585-0060*		**Description** Second Floor - Arrest Room - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		14.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 10.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 13-61 *062224585-0061*		**Description** Second Floor - Main Lobby - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		12.00% Ca Carbonate 22.00% Gypsum 4.00% Mica 12.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-62 *062224585-0062*		**Description** Second Floor - Crime Analyst - Wall Plaster - Brown Coat **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	3.00% Cellulose	12.00% Ca Carbonate 24.00% Gypsum 13.00% Non-fibrous (other) 48.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 14-63 *062224585-0063*		**Description** First Floor - Boiler Room - Internal Boiler Material **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray/ Tan	3.00% Cellulose	12.00% Ca Carbonate 35.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 14-64 *062224585-0064*		**Description** First Floor - Boiler Room - Internal Boiler Material **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray/ Tan	3.00% Cellulose	14.00% Ca Carbonate 33.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 14-65 *062224585-0065*		**Description** First Floor - Boiler Room - Internal Boiler Material **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray/ Tan	3.00% Cellulose	14.00% Ca Carbonate 39.00% Non-fibrous (other) 44.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color		Non-Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID 15-66		**Description**	First Floor - Boiler Room - Duct Insulation - Cementitious			
062224585-0066		**Homogeneity**	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray		None	33.00% Ca Carbonate 50.00% Non-fibrous (other)	**17.00% Chrysotile**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 15-67		**Description**	First Floor - Boiler Room - Duct Insulation - Cementitious			
062224585-0067		**Homogeneity**	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray/ White	18.00% Min. Wool		35.00% Ca Carbonate 36.00% Non-fibrous (other)	**11.00% Chrysotile**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 15-68		**Description**	First Floor - Boiler Room - Duct Insulation - Cementitious			
062224585-0068		**Homogeneity**	Heterogeneous			
PLM NYS 198.1 Friable	11/29/2022	Gray/ Tan	10.00% Min. Wool		35.00% Ca Carbonate 41.70% Non-fibrous (other) 8.00% Quartz	**5.30% Chrysotile**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 16-69		**Description**	First Floor - Boiler Room - Duct Insulation - Cloth			
062224585-0069		**Homogeneity**	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	55.00% Cellulose		30.00% Ca Carbonate 15.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 16-70		**Description**	First Floor - Boiler Room - Duct Insulation - Cloth			
062224585-0070		**Homogeneity**	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	50.00% Cellulose		35.00% Ca Carbonate 15.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID 16-71		**Description**	First Floor - Boiler Room - Duct Insulation - Cloth			
062224585-0071		**Homogeneity**	Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	40.00% Cellulose		33.00% Ca Carbonate 19.00% Non-fibrous (other) 8.00% Quartz	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224585
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 16-72 *062224585-0072*		**Description** Exterior of Building - Exterior Brick **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan	3.00% Cellulose	12.00% Ca Carbonate 50.00% Non-fibrous (other) 35.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 17-73 *062224585-0073*		**Description** Exterior of Building - Exterior Brick **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Red	3.00% Cellulose	18.00% Ca Carbonate 49.00% Non-fibrous (other) 30.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 18-74 *062224585-0074*		**Description** Exterior of Building - Exterior Brick Mortar **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		30.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 18-75 *062224585-0075*		**Description** Exterior of Building - Exterior Brick Mortar **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	11/29/2022	Tan		24.00% Ca Carbonate 4.00% Mica 12.00% Non-fibrous (other) 60.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 11/29/2022 14:46:38

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062224585
Customer ID:	JCBR50
Customer PO:	
Project ID:	

Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Sample Receipt Date:	11/28/2022	Sample Receipt Time:	5:04 PM
Analysis Completed Date:	11/28/2022	Analysis Completed Time:	6:42 PM

Analyst(s):

Erick Rosa PLM NYS 198.1 Friable (21)

Jimmy Encalada PLM NYS 198.1 Friable (37)

Sawyer Fries PLM NYS 198.1 Friable (17)

Samples reviewed and approved by:

Daniel Clarke, Asbestos Laboratory Manager
or Other Approved Signatory

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EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469, NVLAP Lab Code 101048-10

Initial report from: 11/29/2022 14:46:38

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Reported Date: 12/2/2022
Revision#: R0
Revision Comment: Initial Report

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1
Hauppauge, NY 11788

Phone: 631-584-5492
Email: PFazio@JCBroderick.com

DRAFT

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 11/28/2022. The results are tabulated on the attached data pages for the following client designated project:

2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

The reference number for these samples is EMSL Order #062224585. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (516)997-7251.

Daniel Clarke, Asbestos Laboratory Manager

or other approved signatory

The test results contained within this report meet the requirements of NELAP and/or the specific certification program that is applicable, unless otherwise noted.

NYS ELAP ID: Carle Place, NY 11469

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. When the information supplied by the customer can affect the validity of the results, it will be noted on the report.

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1

Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Phone: 631-584-5492
Email: PFazio@JCBroderick.com

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite

Lab Number	*Client Sample Identification*	Appearance	Percentage Matrix Material	Percentage non-Asbestos Fibers	Chrysotile Percentage	Amphibole Percentage	Total Percentage
062224585-0018	9-18	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0019	9-19	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0020	9-20	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0021	9-21	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0022	9-22	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0023	9-23	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0024	9-24	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0025	9-25	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
062224585-0026	9-26	Beige Fibrous Heterogeneous	100.00	0.0	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected

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Report Date	Report Revision	Revision Comments
12/2/2022	R0	Initial Report

Daniel Clarke, Asbestos Laboratory Manager

or other approved signatory

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1

Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Phone: 631-584-5492
Email: PFazio@JCBroderick.com

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite

Lab Number	*Client Sample Identification*	Appearance	Percentage Matrix Material	Percentage non-Asbestos Fibers	Chrysotile Percentage	Amphibole Percentage	Total Percentage

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Attention: Paul Fazio
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Phone: 631-584-5492
Email: PFazio@JCBroderick.com

Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0018 **Crucible ID:** 9-18

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	36.1674
Weight of Crucible and Sub Sample	40.3635
Weight of Sub-Sample	4.1961
Ashing	
Weight of Crucible & Ash	39.6777
Weight of Ash	3.5103
Weight Loss During Ashing	0.6858
Weight Percent Organic and Water	16.3437
Acid Treatment/ Flotation	
Weight of Dish for Floats	0.0000
Weight of Dish & Floats- 1	0.0000
Weight of Dish & Floats- 2	0.0000
Weight of Floats	0.0000
Weight Percent Floats	0.0000
Weight of Dish & Filter for Residue	8.1018
Weight of Dish & Filter & Residue- 1	8.6959
Weight of Dish & Filter & Residue- 2	8.6944
Weight of Residue	0.5926
Weight Loss During Acid/Flotation Treatment	2.9177
Weight Percent Acid-Soluble/Float Materials	69.5336
Weight Percent Residue	14.1226

%Diff Criteria <3%: 0.0000

%Diff Criteria <3%: 0.0173

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties				1.550 RI Lot#:		Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties				1.625 RI Lot#:		Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	8.6677
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	8.6596
Weight of Balance of Residue	0.5578
Weight of Dish & Filter for Centrifugate	8.7652
Weight of Dish & Filter & Centrifugate- 1	8.7992
Weight of Dish & Filter & Centrifugate- 2	8.8000
Weight of Centrifugate	0.0348
Weight Percent Centrifiugate	0.8811

%Diff Criteria <3%: 0.0935

%Diff Criteria <3%: 0.0091

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Attention: Paul Fazio
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Phone: 631-584-5492
Email: PFazio@JCBroderick.com

Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0019 **Crucible ID:** 9-19

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	44.4950
Weight of Crucible and Sub Sample	48.0515
Weight of Sub-Sample	3.5565
Ashing	
Weight of Crucible & Ash	47.4803
Weight of Ash	2.9853
Weight Loss During Ashing	0.5712
Weight Percent Organic and Water	16.0607
Acid Treatment/ Flotation	
Weight of Dish for Floats	8.7126
Weight of Dish & Floats- 1	8.7688
Weight of Dish & Floats- 2	8.7680
Weight of Floats	0.0554
Weight Percent Floats	1.5577
Weight of Dish & Filter for Residue	8.0284
Weight of Dish & Filter & Residue- 1	8.7282
Weight of Dish & Filter & Residue- 2	8.7264
Weight of Residue	0.6980
Weight Loss During Acid/Flotation Treatment	2.2319
Weight Percent Acid-Soluble/Float Materials	62.7555
Weight Percent Residue	19.6260

%Diff Criteria <3%: 0.0091

%Diff Criteria <3%: 0.0206

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties				1.550 RI Lot#:		Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties				1.625 RI Lot#:		Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	8.7250
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	8.7195
Weight of Balance of Residue	0.6911
Weight of Dish & Filter for Centrifugate	8.1873
Weight of Dish & Filter & Centrifugate- 1	8.2438
Weight of Dish & Filter & Centrifugate- 2	8.2439
Weight of Centrifugate	0.0566
Weight Percent Centrifiugate	1.6073

%Diff Criteria <3%: 0.0631

%Diff Criteria <3%: 0.0012

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ORDER ID: 062224585
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Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0020 **Crucible ID:** 9-20

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	38.7085
Weight of Crucible and Sub Sample	41.7226
Weight of Sub-Sample	3.0141
Ashing	
Weight of Crucible & Ash	41.2227
Weight of Ash	2.5142
Weight Loss During Ashing	0.4999
Weight Percent Organic and Water	16.5854
Acid Treatment/ Flotation	
Weight of Dish for Floats	8.4771
Weight of Dish & Floats- 1	8.5080
Weight of Dish & Floats- 2	8.5068
Weight of Floats	0.0297
Weight Percent Floats	0.9854
Weight of Dish & Filter for Residue	8.7281
Weight of Dish & Filter & Residue- 1	9.1853
Weight of Dish & Filter & Residue- 2	9.1845
Weight of Residue	0.4564
Weight Loss During Acid/Flotation Treatment	2.0281
Weight Percent Acid-Soluble/Float Materials	67.2871
Weight Percent Residue	15.1422

%Diff Criteria <3%	
	0.0141
	0.0087

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties				1.550 RI Lot#:		Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties				1.625 RI Lot#:		Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation		%Diff Criteria <3%
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	9.1766	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	9.1725	0.0447
Weight of Balance of Residue	8.2788	
Weight of Dish & Filter for Centrifugate	8.2394	
Weight of Dish & Filter & Centrifugate- 1	8.2809	
Weight of Dish & Filter & Centrifugate- 2	8.2788	0.0254
Weight of Centrifugate	0.0394	
Weight Percent Centrifiugate	0.0721	

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

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Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0021 **Crucible ID:** 9-21

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	41.4230
Weight of Crucible and Sub Sample	44.4525
Weight of Sub-Sample	3.0295
Ashing	
Weight of Crucible & Ash	43.9672
Weight of Ash	2.5442
Weight Loss During Ashing	0.4853
Weight Percent Organic and Water	16.0191
Acid Treatment/ Flotation	
Weight of Dish for Floats	8.2244
Weight of Dish & Floats- 1	8.3715
Weight of Dish & Floats- 2	8.3715
Weight of Floats	0.1471
Weight Percent Floats	4.8556
Weight of Dish & Filter for Residue	8.6719
Weight of Dish & Filter & Residue- 1	9.0840
Weight of Dish & Filter & Residue- 2	9.0827
Weight of Residue	0.4108
Weight Loss During Acid/Flotation Treatment	1.9863
Weight Percent Acid-Soluble/Float Materials	65.5653
Weight Percent Residue	13.5600

%Diff Criteria <3%	
	0.0000
	0.0143

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties			1.550 RI Lot#:			Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties			1.625 RI Lot#:			Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation		%Diff Criteria <3%
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	9.0809	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	9.0788	0.0231
Weight of Balance of Residue	0.4069	
Weight of Dish & Filter for Centrifugate	8.1082	
Weight of Dish & Filter & Centrifugate- 1	8.1277	
Weight of Dish & Filter & Centrifugate- 2	8.1256	0.0258
Weight of Centrifugate	0.0174	
Weight Percent Centrifiugate	0.5799	

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

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Phone: 631-584-5492
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Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0022 **Crucible ID:** 9-22

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	38.1651
Weight of Crucible and Sub Sample	41.2856
Weight of Sub-Sample	3.1205
Ashing	
Weight of Crucible & Ash	40.7880
Weight of Ash	2.6229
Weight Loss During Ashing	0.4976
Weight Percent Organic and Water	15.9462
Acid Treatment/ Flotation	
Weight of Dish for Floats	8.6559
Weight of Dish & Floats- 1	8.6941
Weight of Dish & Floats- 2	8.6926
Weight of Floats	0.0367
Weight Percent Floats	1.1761
Weight of Dish & Filter for Residue	8.0327
Weight of Dish & Filter & Residue- 1	8.6560
Weight of Dish & Filter & Residue- 2	8.6529
Weight of Residue	0.6202
Weight Loss During Acid/Flotation Treatment	1.9660
Weight Percent Acid-Soluble/Float Materials	63.0027
Weight Percent Residue	19.8750

%Diff Criteria <3%: 0.0173 | 0.0358

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties — 1.550 RI Lot#: — Temperature (C°):

⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties — 1.625 RI Lot#: — Temperature (C°)

⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	8.6559
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	8.6527
Weight of Balance of Residue	0.6200
Weight of Dish & Filter for Centrifugate	8.6725
Weight of Dish & Filter & Centrifugate- 1	8.7130
Weight of Dish & Filter & Centrifugate- 2	8.7105
Weight of Centrifugate	0.0380
Weight Percent Centrifiugate	1.2181

%Diff Criteria <3%: 0.0370 | 0.0287

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL CUSTOMER ID: JCBR50

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EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0023 **Crucible ID:** 9-23

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	35.2261
Weight of Crucible and Sub Sample	39.8579
Weight of Sub-Sample	4.6318

Ashing	
Weight of Crucible & Ash	39.0321
Weight of Ash	3.8060
Weight Loss During Ashing	0.8258
Weight Percent Organic and Water	17.8289

Acid Treatment/ Flotation		
Weight of Dish for Floats	0.0000	%Diff
Weight of Dish & Floats- 1	0.0000	Criteria <3%
Weight of Dish & Floats- 2	0.0000	0.0000
Weight of Floats	0.0000	
Weight Percent Floats	0.0000	
Weight of Dish & Filter for Residue	8.7305	%Diff
Weight of Dish & Filter & Residue- 1	9.6641	Criteria <3%
Weight of Dish & Filter & Residue- 2	9.6579	0.0642
Weight of Residue	0.9274	
Weight Loss During Acid/Flotation Treatment	2.8786	
Weight Percent Acid-Soluble/Float Materials	62.1486	
Weight Percent Residue	20.0225	

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties			1.550 RI Lot#:			Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties			1.625 RI Lot#:			Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation		
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	9.6496	%Diff Criteria <3%
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	9.6501	0.0052
Weight of Balance of Residue	0.9196	
Weight of Dish & Filter for Centrifugate	8.6722	%Diff
Weight of Dish & Filter & Centrifugate- 1	8.7584	Criteria <3%
Weight of Dish & Filter & Centrifugate- 2	8.7575	0.0103
Weight of Centrifugate	0.0853	
Weight Percent Centrifiugate	1.8572	

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ORDER ID: 062224585
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EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0024 **Crucible ID:** 9-24

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	35.7360
Weight of Crucible and Sub Sample	39.6199
Weight of Sub-Sample	3.8839

Ashing	
Weight of Crucible & Ash	38.9859
Weight of Ash	3.2499
Weight Loss During Ashing	0.6340
Weight Percent Organic and Water	16.3238

Acid Treatment/ Flotation		
Weight of Dish for Floats	0.0000	%Diff
Weight of Dish & Floats- 1	0.0000	Criteria <3%
Weight of Dish & Floats- 2	0.0000	0.0000
Weight of Floats	0.0000	
Weight Percent Floats	0.0000	
Weight of Dish & Filter for Residue	8.1039	%Diff
Weight of Dish & Filter & Residue- 1	8.6351	Criteria <3%
Weight of Dish & Filter & Residue- 2	8.6337	0.0162
Weight of Residue	0.5298	
Weight Loss During Acid/Flotation Treatment	2.7201	
Weight Percent Acid-Soluble/Float Materials	70.0353	
Weight Percent Residue	13.6409	

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties			1.550 RI Lot#:			Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties			1.625 RI Lot#:			Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation		
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	8.6321	%Diff Criteria <3%
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	8.6306	0.0174
Weight of Balance of Residue	0.5267	
Weight of Dish & Filter for Centrifugate	8.1038	%Diff
Weight of Dish & Filter & Centrifugate- 1	8.1565	Criteria <3%
Weight of Dish & Filter & Centrifugate- 2	8.1566	0.0012
Weight of Centrifugate	0.0528	
Weight Percent Centrifiugate	1.3675	

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0025 **Crucible ID:** 9-25

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	37.5519
Weight of Crucible and Sub Sample	41.0727
Weight of Sub-Sample	3.5208

Ashing	
Weight of Crucible & Ash	40.4912
Weight of Ash	
Weight Loss During Ashing	3.5208
Weight Percent Organic and Water	100.0000

Acid Treatment/ Flotation		
Weight of Dish for Floats	0.0000	%Diff
Weight of Dish & Floats- 1	0.0000	Criteria <3%
Weight of Dish & Floats- 2	0.0000	0.0000
Weight of Floats	0.0000	
Weight Percent Floats	0.0000	
Weight of Dish & Filter for Residue	8.4960	%Diff
Weight of Dish & Filter & Residue- 1	8.9859	Criteria <3%
Weight of Dish & Filter & Residue- 2	8.9834	0.0278
Weight of Residue	0.4874	
Weight Loss During Acid/Flotation Treatment	-0.4874	
Weight Percent Acid-Soluble/Float Materials	-13.8434	
Weight Percent Residue	13.8434	

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties			1.550 RI Lot#:			Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties			1.625 RI Lot#:			Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation		
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	8.9796	%Diff Criteria <3%
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	8.9794	0.0022
Weight of Balance of Residue	0.4834	
Weight of Dish & Filter for Centrifugate	8.0338	%Diff
Weight of Dish & Filter & Centrifugate- 1	8.0638	Criteria <3%
Weight of Dish & Filter & Centrifugate- 2	8.0641	0.0037
Weight of Centrifugate	0.0303	
Weight Percent Centrifiugate	0.8677	

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Asbestos Analysis of NYS ELAP Method 198.8
PLM Analysis for Asbestos in Bulk Surfacing Materials Containing Vermiculite
Bench Sheet

EMSL Sample ID 062224585-0026 **Crucible ID:** 9-26

	Analyst	Date
Gravimetric Prep	RC	12/1/2022
Chrysotile Analysis	ER	12/2/2022
Centrifugation Date	SF	12/2/2022
Amphibole Analysis	TM	12/2/2022

Stereoscopic			
Color	Beige	Stereoscopic % Asbestos	
Texture	Fibrous		
Homogeneity	Heterogeneous	Vermiculite Detected	Yes

*Initial Weights**	
Weight of Crucible	38.5629
Weight of Crucible and Sub Sample	41.8417
Weight of Sub-Sample	3.2788
Ashing	
Weight of Crucible & Ash	41.3176
Weight of Ash	2.7547
Weight Loss During Ashing	0.5241
Weight Percent Organic and Water	15.9845
Acid Treatment/ Flotation	
Weight of Dish for Floats	8.0916
Weight of Dish & Floats- 1	8.1344
Weight of Dish & Floats- 2	8.1344
Weight of Floats	0.0428
Weight Percent Floats	1.3054
Weight of Dish & Filter for Residue	8.6686
Weight of Dish & Filter & Residue- 1	9.1556
Weight of Dish & Filter & Residue- 2	9.1545
Weight of Residue	0.4859
Weight Loss During Acid/Flotation Treatment	2.2260
Weight Percent Acid-Soluble/Float Materials	67.8907
Weight Percent Residue	14.8194

%Diff Criteria <3%
0.0000
%Diff Criteria <3%
0.0120

%Diff Criteria <3%
0.0055
%Diff Criteria <3%
0.0087

Non-Asbestos Fiber	Optical Property	Visual %	Calc %
			0
			0

Slide 9 Chrysotile ID Optical Properties				1.550 RI Lot#:		Temperature (C°):	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

Slide 9 Amphibole ID Optical Properties				1.625 RI Lot#:		Temperature (C°)	
⊥ RI	IIRI	Morphology	Sign	Pleochorism	Birefringence	Fiber Color	Extinction

PLM Examination of Residue (Chrysotile)	Analyzed	PTCT	Chrysotile	Non-Empty	PTCT:	Chrysotile	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Chrysotile Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Chrysotile by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Chrysotile in Sample [1]	0.0000	Slide 4:	0	50	Slide 8:	0	50	

[1] If greater than 1% no further analysis needed

Heavy Liquid Centrifugation	
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 1	9.1494
Weight of Dish & Filter & Balance of Residue (Post Chrysotile Analysis)- 2	9.1499
Weight of Balance of Residue	0.4813
Weight of Dish & Filter for Centrifugate	8.0298
Weight of Dish & Filter & Centrifugate- 1	8.0529
Weight of Dish & Filter & Centrifugate- 2	8.0536
Weight of Centrifugate	0.0238
Weight Percent Centrifiugate	0.7328

PLM Examination of Centrifugate (Amphibole)	Analyzed	PTCT	Amphibole	Non-Empty	PTCT	Amphibole	Non-Empty	Trace Detected?
Number of Occupied Points	400	Slide 1:	0	50	Slide 5:	0	50	*dropdown select*
Number of Amphibole Points	0	Slide 2:	0	50	Slide 6:	0	50	
Percent Amphibole by PTCT	0.00	Slide 3:	0	50	Slide 7:	0	50	**No**
Percent Amphibole in Sample	0.0000	Slide 4:	0	50	Slide 8:	0	50	

Percent of Total Asbestos in Sample	**0.0000**

** All Weights in grams*

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EMSL ANALYTICAL, INC.
528 Mineola Avenue
Carle Place, NY 11514
Phone/Fax: (516)997-7251 / (516)997-7528
carleplacelab@emsl.com | http://www.EMSL.com

EMSL ORDER ID: 062224585
EMSL CUSTOMER ID: JCBR50

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North,
Suite 1
Hauppauge, NY 11788

Phone: 631-584-5492
Email: PFazio@JCBroderick.com

Customer PO:
EMSL Project ID:
Project Name: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, New York 11797, JCB - 2nd Police Precinct, Project #22-53344

Collected: 11/28/2022
Received: 11/28/2022
Analyzed: 12/2/2022
Reported: 12/2/2022

Signature Page

Report Date	Report Revision	Revision Comments
12/2/2022	R0	Initial Report

Daniel Clarke, Asbestos Laboratory Manager

or other approved signatory

Additional Comments: NYS ELAP ID: 11469

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About us

EMSL Analytical, Inc. offers a full line of analytical solutions for over 30 years across North America. For more information about our nationally accredited locations, vast line of testing services, and our food safety solutions please visit www.EMSL.com or call (800) 220-3675.

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062224586

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT # : 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME : Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY : EMSL
TURNAROUND TIME : (CIRCLE ONE) 24 HOUR | (12 HOUR) | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
76	19	2x4 Ceiling Tile Fissure Speckled	First Floor BSO Office	ASB
77	19	2x4 Ceiling Tile Fissure Speckled	First Floor BSO Office	ASB
78	20	2x4 Ceiling Tile Speckled	First Floor Corridor	ASB
79	20	2x4 Ceiling Tile Speckled	First Floor Corridor	ASB
80	21	2x4 Ceiling Tile Long Fissure	First Floor BSO Office	ASB
81	21	2x4 Ceiling Tile Long Fissure	First Floor BSO Office	ASB
82	22	2x4 Ceiling Tile, Fake 1x1	Secretary's Office	ASB
83	22	2x4 Ceiling Tile, Fake 1x1	Secretary's Office	ASB
84	23	2x2 Ceiling Tile Fissure	Second Floor Room 32	ASB
85	23	2x2 Ceiling Tile Fissure	Second Floor Room 32	ASB
86	24	1x1 Ceiling Tile, Speckle	First Floor Gym	ASB
87	24	1x1 Ceiling Tile, Speckle	Second Floor Time Room	ASB
88	25	1x1 Ceiling Tile, Deep Fissure	First Floor Gym	ASB
89	25	1x1 Ceiling Tile, Deep Fissure	First Floor Gym	ASB
90	26	12x12 Floor Tile Pink	Second Floor Room 32	ASB
91	26	12x12 Floor Tile Pink	Second Floor Main Desk	ASB
92	27	12x12 Floor Tile Pink Mastic	Second Floor Room 32	ASB
93	27	12x12 Floor Tile Pink Mastic	Second Floor Main Desk	ASB
94	28	12x12 Floor Tile White	Second Floor Main Desk	ASB

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RECEIVED 2022 NOV 28 P 5:04

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao	S.	11.28.22	14.29	Alex Hoschar		11/28/22	5:04PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Erick Rosa		11/29/22	

M Henderson 11/29/22

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

OrderID: 062224586

062224586

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT # : 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME : Shangkun Xiao
SAMPLER'S SIGN:
LABORATORY : EMSL
TURNAROUND TIME : (CIRCLE ONE) 24 HOUR | (12 HOUR) | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
95	28	12x12 Floor Tile White	Second Floor Main Desk	ASB
96	29	12x12 Floor Tile White Mastic	Second Floor Main Desk	ASB
97	29	12x12 Floor Tile White Mastic	Second Floor Main Desk	ASB
98	30	12x12 Floor Tile Dark Gray	Second Floor Corridor North	ASB
99	30	12x12 Floor Tile Dark Gray	Second Floor Corridor North	ASB
100	31	12x12 Floor Tile Dark Gray Mastic	Second Floor Corridor North	ASB
101	31	12x12 Floor Tile Dark Gray Mastic	Second Floor Corridor North	ASB
102	32	12x12 Floor Tile Brown	First Floor BSO Office	ASB
103	32	12x12 Floor Tile Brown	First Floor JAB Office	ASB
104	33	12x12 Floor Tile Brown Mastic	First Floor BSO Office	ASB
105	33	12x12 Floor Tile Brown Mastic	First Floor JAB Office	ASB
106	34	12x12 Floor Tile Gray	First Floor Kitchen	ASB
107	34	12x12 Floor Tile Gray	Second Floor Corridor South (Lower Layer)	ASB
108	35	12x12 Floor Tile Gray Mastic	First Floor Kitchen	ASB
109	35	12x12 Floor Tile Gray Mastic	Second Floor Corridor South (Lower Layer)	ASB
110	36	Carpet Mastic	First Floor Secretary's Office	ASB
111	36	Carpet Mastic	First Floor Supervisor's Office	ASB
112	37	Floor Tile, Second Layer	First Floor Pop Office	ASB
113	37	Floor Tile, Second Layer	First Floor JAB Office	ASB

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RECEIVED NOV 28 2022 CARLE PLACE, NY

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao		11.28.22	14.29	Alex Wschn		11/28/22	5:05pm
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Erick Rosa		11/29/22	

M Abernathy 11/29/22

J.C. BRODERICK & ASSOCIATES

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Jordan Deary 11/29/22

062224586

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | (12 HOUR) | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
114	38	Floor Tile, Second Layer, Mastic	First Floor Pop Office	ASB
115	38	Floor Tile, Second Layer, Mastic	First Floor JAB Office	ASB
116	39	Cove Base Black	Second Floor Room 32	ASB
117	39	Cove Base Black	Second Floor Main Desk	ASB
118	40	Cove Base Black Mastic	Second Floor Room 32	ASB
119	40	Cove Base Black Mastic	Second Floor Main Desk	ASB
120	41	Interior Window Glazing	First Floor Secretary's Office	ASB
121	41	Interior Window Glazing	First Floor Supervisor's Office	ASB
122	42	Exterior Door Caulking	Exterior of Building	ASB
123	42	Exterior Door Caulking	Exterior of Building	ASB
124	43	Exterior Window Caulking	Exterior of Building	ASB
125	43	Exterior Window Caulking	Exterior of Building	ASB
126	44	Exterior Window Glazing	Exterior of Building	ASB
127	44	Exterior Window Glazing	Exterior of Building	ASB
128	45	Roof Shingle Upper Layer	Roof	ASB
129	45	Roof Shingle Upper Layer	Roof	ASB
130	46	Roof Shingle Lower Layer	Roof	ASB
131	46	Roof Shingle Lower Layer	Roof	ASB
132	47	Roof Tar Paper	Roof	ASB

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2022 NOV 28 P 5:05
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SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao	S.	11.28.22	14.29	Alex Nash		11/28/22	5:05PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Erick Rosa		11/29/22	

M Hawkins 11/29/22

Jordana Dicarlo 11/29/22

J.C. BRODERICK & ASSOCIATES

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OrderID: 062224586

062224586

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury, New York,11797
DATE: 11.28.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN:
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | (12 HOUR) | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
133	47	Roof Tar Paper	Roof	ASB

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CARLE PLACE, NY
2022 NOV 28 P 5:05

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Shangkun Xiao		11.28.22	14.29	Alex Wash		11/28/22	5:05pm
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Erick Roca		11/29/22	

M Silverstein 11/29/22

Jordan Deans

J.C. BRODERICK & ASSOCIATES
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EMSL Analytical, Inc.

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1
Hauppauge, NY 11788

Phone: (631) 584-5492
Fax:
Received Date: 11/28/2022 5:04 PM
Analysis Date: 11/29/2022
Collected Date: 11/28/2022

Project: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury New York 11797, JCB - 2nd Police Precinct, #: 22-53344

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 19-76 *062224586-0001*		**Description** First Floor BSO Office - 2x4 Ceiling Tile Fissure Speckled **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	12.00% Min. Wool	88.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 19-77 *062224586-0002*		**Description** First Floor BSO Office - 2x4 Ceiling Tile Fissure Speckled **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	8.80% Min. Wool	91.20% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 20-78 *062224586-0003*		**Description** First Floor Corridor - 2x4 Ceiling Tile Speckled **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	3.40% Min. Wool	96.60% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 20-79 *062224586-0004*		**Description** First Floor Corridor - 2x4 Ceiling Tile Speckled **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	3.90% Min. Wool	96.10% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 21-80 *062224586-0005*		**Description** First Floor BSO Office - 2x4 Ceiling Tile Long Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Tan/ White	9.60% Min. Wool	90.40% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Tan/ White		100.00% Other	**None Detected**

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Initial report from: 11/29/2022 15:44:21

EMSL Analytical, Inc.
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 21-81 *062224586-0006*		**Description** First Floor BSO Office - 2x4 Ceiling Tile Long Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Tan/ White	9.70% Min. Wool	90.30% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Tan/ White		100.00% Other	**None Detected**
Sample ID 22-82 *062224586-0007*		**Description** Secretary's Office - 2x4 Ceiling Tile, Fake 1x1 **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	6.10% Min. Wool	93.90% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 22-83 *062224586-0008*		**Description** Secretary's Office - 2x4 Ceiling Tile, Fake 1x1 **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	5.10% Min. Wool	94.90% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 23-84 *062224586-0009*		**Description** Second Floor Room 32 - 2x2 Ceiling Tile Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	10.00% Min. Wool	90.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 23-85 *062224586-0010*		**Description** Second Floor Room 32 - 2x2 Ceiling Tile Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	8.30% Min. Wool	91.70% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 24-86 *062224586-0011*		**Description** First Floor Gym - 1x1 Ceiling Tile, Speckle **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	3.60% Min. Wool	96.40% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**

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Initial report from: 11/29/2022 15:44:21

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 24-87 *062224586-0012*		**Description** Second Floor Time Room - 1x1 Ceiling Tile, Speckle **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	<1.00% Min. Wool	100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 25-88 *062224586-0013*		**Description** First Floor Gym - 1x1 Ceiling Tile, Deep Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	6.00% Min. Wool	94.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 25-89 *062224586-0014*		**Description** First Floor Gym - 1x1 Ceiling Tile, Deep Fissure **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Tan/ White	5.70% Min. Wool	94.30% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Tan/ White		100.00% Other	**None Detected**
Sample ID 26-90 *062224586-0015*		**Description** Second Floor Room 32 - 12x12 Floor Tile Pink **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Pink		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Pink		100.00% Other	**None Detected**
Sample ID 26-91 *062224586-0016*		**Description** Second Floor Main Desk - 12x12 Floor Tile Pink **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Pink		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Pink		100.00% Other	**None Detected**
Sample ID 27-92 *062224586-0017*		**Description** Second Floor Room 32 - 12x12 Floor Tile Pink Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Yellow		100.00% Other	**None Detected**

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Initial report from: 11/29/2022 15:44:21

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 27-93 *062224586-0018*		**Description** Second Floor Main Desk - 12x12 Floor Tile Pink Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Yellow		100.00% Other	**None Detected**
Sample ID 28-94 *062224586-0019*		**Description** Second Floor Main Desk - 12x12 Floor Tile White **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	White/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	White/ Black	None	100.00% Other	**<1% Chrysotile**
Sample ID 28-95 *062224586-0020*		**Description** Second Floor Main Desk - 12x12 Floor Tile White **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	White/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	White/ Black	None	100.00% Other	**<1% Chrysotile**
Sample ID 29-96 *062224586-0021*		**Description** Second Floor Main Desk - 12x12 Floor Tile White Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Yellow		100.00% Other	**None Detected**
Sample ID 29-97 *062224586-0022*		**Description** Second Floor Main Desk - 12x12 Floor Tile White Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Yellow		100.00% Other	**None Detected**
Sample ID 30-98 *062224586-0023*		**Description** Second Floor Corridor North - 12x12 Floor Tile Dark Gray **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ Black	None	96.70% Other	**3.30% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**

DRAFT

Initial report from: 11/29/2022 15:44:21

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 30-99 *062224586-0024*		**Description** Second Floor Corridor North - 12x12 Floor Tile Dark Gray **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ Black	None	96.50% Other	**3.50% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 31-100 *062224586-0025*		**Description** Second Floor Corridor North - 12x12 Floor Tile Dark Gray Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	98.70% Other	**1.30% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 31-101 *062224586-0026*		**Description** Second Floor Corridor North - 12x12 Floor Tile Dark Gray Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	98.80% Other	**1.20% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 32-102 *062224586-0027*		**Description** First Floor BSO Office - 12x12 Floor Tile Brown **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown	None	98.80% Other	**1.20% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 32-103 *062224586-0028*		**Description** First Floor JAB Office - 12x12 Floor Tile Brown **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown	None	98.80% Other	**1.20% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 33-104 *062224586-0029*		**Description** First Floor BSO Office - 12x12 Floor Tile Brown Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Brown	None	100.00% Other	**<1% Chrysotile**

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EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 33-105 *062224586-0030*		**Description**	First Floor JAB Office - 12x12 Floor Tile Brown Mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Brown	None	100.00% Other	**<1% Chrysotile**
Sample ID 34-106 *062224586-0031*		**Description**	First Floor Kitchen - 12x12 Floor Tile Gray		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray	None	100.00% Other	**Inconclusive : <1% Chrysotile**
TEM NYS 198.4 NOB	11/29/2022	Gray	None	100.00% Other	**<1% Chrysotile**
Sample ID 34-107 *062224586-0032*		**Description**	Second Floor Corridor South (Lower Layer) - 12x12 Floor Tile Gray		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray	None	100.00% Other	**Inconclusive : <1% Chrysotile**
TEM NYS 198.4 NOB	11/29/2022	Gray	None	100.00% Other	**<1% Chrysotile**
Sample ID 35-108 *062224586-0033*		**Description**	First Floor Kitchen - 12x12 Floor Tile Gray Mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	98.80% Other	**1.20% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 35-109 *062224586-0034*		**Description**	Second Floor Corridor South (Lower Layer) - 12x12 Floor Tile Gray Mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	98.30% Other	**1.70% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 36-110 *062224586-0035*		**Description**	First Floor Secretary's Office - Carpet Mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown/ Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Brown/ Yellow		100.00% Other	**None Detected**

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 36-111 *062224586-0036*		**Description**	First Floor Supervisor's Office - Carpet Mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown/ Yellow		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Brown/ Yellow	None	100.00% Other	**<1% Chrysotile**
Sample ID 37-112 *062224586-0037*		**Description**	First Floor Pop Office - Floor Tile, Second Layer		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown	None	100.00% Other	**Inconclusive : <1% Chrysotile**
TEM NYS 198.4 NOB	11/29/2022	Brown	None	100.00% Other	**<1% Chrysotile**
Sample ID 37-113 *062224586-0038*		**Description**	First Floor JAB Office - Floor Tile, Second Layer		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown	None	100.00% Other	**Inconclusive : <1% Chrysotile**
TEM NYS 198.4 NOB	11/29/2022	Brown	None	100.00% Other	**<1% Chrysotile**
Sample ID 38-114 *062224586-0039*		**Description**	First Floor Pop Office - Floor Tile, Second Layer, mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	95.40% Other	**4.60% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 38-115 *062224586-0040*		**Description**	First Floor JAB Office - Floor Tile, Second Layer, mastic		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Beige	None	97.00% Other	**3.00% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 39-116 *062224586-0041*		**Description**	Second Floor Room 32 - Cove Base Black		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**

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EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 39-117 *062224586-0042*		**Description** Second Floor Main Desk - Cove Base Black **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**
Sample ID 40-118 *062224586-0043*		**Description** Second Floor Room 32 - Cove Base Black Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Tan/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Tan/ Beige		100.00% Other	**None Detected**
Sample ID 40-119 *062224586-0044*		**Description** Second Floor Main Desk - Cove Base Black Mastic **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Tan/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Tan/ Beige		100.00% Other	**None Detected**
Sample ID 41-120 *062224586-0045*		**Description** First Floor Secretary's Office - Interior Window Glazing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	White		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	White		100.00% Other	**None Detected**
Sample ID 41-121 *062224586-0046*		**Description** First Floor Supervisor's Office - Interior Window Glazing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	White/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	White/ Beige	None	98.50% Other	**1.50% Chrysotile**
Sample ID 42-122 *062224586-0047*		**Description** Exterior of Building - Exterior Door Caulking **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	None	98.40% Other	**<1% Anthophyllite** **1.30% Chrysotile** **1.6% Total**
TEM NYS 198.4 NOB					**Not Analyzed**

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 42-123 *062224586-0048*		**Description** Exterior of Building - Exterior Door Caulking **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Gray/ White	None	97.90% Other	**<1% Anthophyllite 1.70% Chrysotile 2.1% Total**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 43-124 *062224586-0049*		**Description** Exterior of Building - Exterior Window Caulking **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown/ White	None	100.00% Other	**Inconclusive : <1% Anthophyllite**
TEM NYS 198.4 NOB	11/29/2022	Brown/ White	None	100.00% Other	**<1% Anthophyllite <1% Chrysotile <1% Total**
Sample ID 43-125 *062224586-0050*		**Description** Exterior of Building - Exterior Window Caulking **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Brown/ White	None	98.80% Other	**1.20% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 44-126 *062224586-0051*		**Description** Exterior of Building - Exterior Window Glazing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Green	None	95.10% Other	**4.90% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 44-127 *062224586-0052*		**Description** Exterior of Building - Exterior Window Glazing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black/ Green	None	96.50% Other	**3.50% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 45-128 *062224586-0053*		**Description** Roof - Roof Shingle Upper Layer **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black	<1.00% Glass	100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**

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EMSL Order: 062224586
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 45-129 *062224586-0054*		**Description** Roof - Roof Shingle Upper Layer **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black	1.30% Glass	98.70% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**
Sample ID 46-130 *062224586-0055*		**Description** Roof - Roof Shingle Lower Layer **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**
Sample ID 46-131 *062224586-0056*		**Description** Roof - Roof Shingle Lower Layer **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**
Sample ID 47-132 *062224586-0057*		**Description** Roof - Roof Tar Paper **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**
Sample ID 47-133 *062224586-0058*		**Description** Roof - Roof Tar Paper **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	11/29/2022	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	11/29/2022	Black		100.00% Other	**None Detected**

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EMSL Order:	062224586
Customer ID:	JCBR50
Customer PO:	
Project ID:	

Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Sample Receipt Date:	11/28/2022	Sample Receipt Time:	5:04 PM
Analysis Completed Date:	11/29/2022	Analysis Completed Time:	10:21 AM

Analyst(s):

Erick Rosa PLM NYS 198.6 NOB (30)

Michael Hartcorn PLM NYS 198.6 NOB (28)

Jordan Diaz TEM NYS 198.4 NOB (43)

Samples reviewed and approved by:

Daniel Clarke, Asbestos Laboratory Manager
or Other Approved Signatory

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EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469, NVLAP Lab Code 101048-10

Initial report from: 11/29/2022 15:44:21

062225136

Drop Box

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7100, Jericho Turnpike. Woodbury NY 11797
DATE: 12.07.2022
CLIENT: JCB - 2nd Police Precinct.
PROJECT #: 22-53344.

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): (24 HOUR) | 12 HOUR | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM #	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
134	48	Terrazzo Floor	Stair wall	ASB
135	48	〃	〃	
136	49	Gray Ceramic Floor Tile Grout	First Floor Gym Locker Room	
137	49	〃	〃	
138	50	Gray Ceramic Floor Tile Setting Bed	〃	
139	50	〃	〃	
140	51	Gray Ceramic Wall Tile Grout	〃	
141	51	〃	〃	
142	52	Gray Ceramic Wall Tile Glue.	〃	
143	52	〃	〃	
144	53	Pink Ceramic Floor Tile Grout	First Floor Women's Buttroom	
145	53	〃	〃	
146	54	Pink Ceramic Floor Tile Setting Bed	〃	
147	54	〃	〃	
148	55	Pink Ceramic Wall Tile Grout	〃	
149	55	〃	〃	
150	56	Pink Ceramic Wall Tile Glue	〃	
151	56	〃	〃	

RECEIVED EMSL ANALYTICAL INC. CARLE PLACE, NY 2022 DEC -8 P 2:26

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
SHANGKUN XIAO	S.	12.08.22	13:47	Grace Sylcah		12-8-22	2:26 PM
COMMENTS				ANALYST (PRINT) Jimmy Encalada	SIGNATURE	DATE 12/9/22	TIME 12:19 pm

12/9/22
12/9/22
12/9/22

DRAFT

OrderID: 062225136

062225136

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: 2nd Police Precinct
ADDRESS: 7700, Jericho Turnpike. Woolbury NY 11797
DATE: 12.07.2022
CLIENT: JCB - 2nd Police Precinct
PROJECT #: 22-53344
☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Shangkun Xiao
SAMPLER'S SIGN: S.
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): (24 HOUR) | 12 HOUR | 6 HOUR | RUSH | OTHER
MANAGER: Paul Fazio

SAMPLE #	HM #	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
152	57	White Ceramic Floor Tile Grout	Second Floor South Bathroom	ASB
153	57	〃	〃	
154	58	White Ceramic Floor Tile Setting Bed.	〃	
155	58	〃	〃	
156	59	White Ceramic Wall Tile Grout	〃	
157	59	〃	〃	
158	60	White Ceramic Wall Tile Glue.	〃	
159	60	〃	〃	
160	61	Blue Ceramic Floor Tile Grout	Second Floor North Bathroom	
161	61	〃	First Floor Mens Bathroom	
162	62	Blue Ceramic Floor Tile Setting Bed		
163	62	〃		
164	63	Blue Ceramic Wall Tile Grout		
165	63	〃		
166	64	Blue Ceramic Wall Tile Glue		
167	64	〃		

RECEIVED EMSL ANALYTICAL INC CARLE PLACE, NY 2022 DEC -8 P 2:26

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SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
SHANGKUN XIAO	S.	12.08.22	13:47	Grace Salcedo		12-8-22	2.26 PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Jimmy Encalada		12/9/22	12:20 pm

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

12/9/22

12/9/22

Page 2 Of 2
OrderID: 062225136

EMSL Analytical, Inc.

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1
Hauppauge, NY 11788

Phone: (631) 584-5492
Fax:
Received Date: 12/08/2022 2:26 PM
Analysis Date: 12/09/2022
Collected Date: 12/07/2022

Project: 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury NY 11797, JCB - 2nd Police Precinct, #: 22-53344

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 48-134 *062225136-0001*		**Description** Stairwell - Terrazzo Floor **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ White	3.00% Cellulose	65.00% Ca Carbonate 27.00% Non-fibrous (other) 5.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 48-135 *062225136-0002*		**Description** Stairwell - Terrazzo Floor **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ White	3.00% Cellulose	70.00% Ca Carbonate 21.00% Non-fibrous (other) 6.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 49-136 *062225136-0003*		**Description** First Floor Gym Locker Room - Gray Ceramic Floor Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Gray	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 49-137 *062225136-0004*		**Description** First Floor Gym Locker Room - Gray Ceramic Floor Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Gray	3.00% Cellulose	30.00% Ca Carbonate 17.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 12/09/2022 15:08:51

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 50-138 *062225136-0005*		**Description** First Floor Gym Locker Room - Gray Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan		30.00% Ca Carbonate 5.00% Mica 10.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 50-139 *062225136-0006*		**Description** First Floor Gym Locker Room - Gray Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan		28.00% Ca Carbonate 4.00% Mica 13.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 51-140 *062225136-0007*		**Description** First Floor Gym Locker Room - Gray Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ White	3.00% Cellulose	69.00% Ca Carbonate 4.00% Mica 24.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 51-141 *062225136-0008*		**Description** First Floor Gym Locker Room - Gray Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	White	3.00% Cellulose	70.00% Ca Carbonate 23.00% Non-fibrous (other) 4.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 52-142 *062225136-0009*		**Description** First Floor Gym Locker Room - Gray Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Gray/ White		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Gray/ White		100.00% Other	**None Detected**

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 52-143		**Description**	First Floor Gym Locker Room - Gray Ceramic Wall Tile Glue		
062225136-0010		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Gray/ White	1.20% Glass	98.80% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Gray/ White		100.00% Other	**None Detected**
Sample ID 53-144		**Description**	First Floor Women's Bathroom - Pink Ceramic Floor Tile Grout		
062225136-0011		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	12/09/2022	Gray/ Tan	3.00% Cellulose	33.00% Ca Carbonate 20.00% Non-fibrous (other) 44.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 53-145		**Description**	First Floor Women's Bathroom - Pink Ceramic Floor Tile Grout		
062225136-0012		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	12/09/2022	Tan	3.00% Cellulose	30.00% Ca Carbonate 4.00% Mica 13.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 54-146		**Description**	First Floor Women's Bathroom - Pink Ceramic Floor Tile Setting Bed		
062225136-0013		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	12/09/2022	Tan	3.00% Cellulose	27.00% Ca Carbonate 5.00% Mica 15.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 54-147		**Description**	First Floor Women's Bathroom - Pink Ceramic Floor Tile Setting Bed		
062225136-0014		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	12/09/2022	Gray/ Tan	3.00% Cellulose	28.00% Ca Carbonate 24.00% Non-fibrous (other) 45.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 55-148 *062225136-0015*		**Description** First Floor Women's Bathroom - Pink Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ White	3.00% Cellulose	70.00% Ca Carbonate 4.00% Mica 23.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 55-149 *062225136-0016*		**Description** First Floor Women's Bathroom - Pink Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ White	6.00% Cellulose	68.00% Ca Carbonate 5.00% Mica 21.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 56-150 *062225136-0017*		**Description** First Floor Women's Bathroom - Pink Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Tan		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Tan		100.00% Other	**None Detected**
Sample ID 56-151 *062225136-0018*		**Description** First Floor Women's Bathroom - Pink Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Tan		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Tan		100.00% Other	**None Detected**
Sample ID 57-152 *062225136-0019*		**Description** Second Floor South Bathroom - White Ceramic Floor Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Gray/ Tan	5.00% Cellulose	27.00% Ca Carbonate 18.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 57-153 *062225136-0020*		**Description** Second Floor South Bathroom - White Ceramic Floor Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 58-154 *062225136-0021*		**Description** Second Floor South Bathroom - White Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan		30.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 58-155 *062225136-0022*		**Description** Second Floor South Bathroom - White Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Gray		30.00% Ca Carbonate 4.00% Mica 16.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 59-156 *062225136-0023*		**Description** Second Floor South Bathroom - White Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	White	3.00% Cellulose	78.00% Ca Carbonate 4.00% Mica 15.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 59-157 *062225136-0024*		**Description** Second Floor South Bathroom - White Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	White	3.00% Cellulose	75.00% Ca Carbonate 4.00% Mica 18.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 60-158 *062225136-0025*		**Description** Second Floor South Bathroom - White Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Gray/ Green		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Gray/ Green		100.00% Other	**None Detected**

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Initial report from: 12/09/2022 15:08:51

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID 60-159 *062225136-0026*		**Description** Second Floor South Bathroom - White Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Gray/ Green		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Gray/ Green		100.00% Other	**None Detected**
Sample ID 61-160 *062225136-0027*		**Description** Second Floor North Bathroom - Blue Ceramic Floor Tile Grout **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan/ Blue	3.00% Cellulose	26.00% Ca Carbonate 16.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 61-161 *062225136-0028*		**Description** First Floor Men's Bathroom - Blue Ceramic Floor Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan		30.00% Ca Carbonate 4.00% Mica 11.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 62-162 *062225136-0029*		**Description** Second Floor North Bathroom - Blue Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan		22.00% Ca Carbonate 13.00% Non-fibrous (other) 65.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 62-163 *062225136-0030*		**Description** First Floor Men's Bathroom - Blue Ceramic Floor Tile Setting Bed **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	Tan	3.00% Cellulose	30.00% Ca Carbonate 17.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 12/09/2022 15:08:51

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EMSL Order: 062225136
Customer ID: JCBR50
Customer PO:
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 63-164 *062225136-0031*		**Description** Second Floor North Bathroom - Blue Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	White	3.00% Cellulose	68.00% Ca Carbonate 6.00% Mica 23.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 63-165 *062225136-0032*		**Description** First Floor Men's Bathroom - Blue Ceramic Wall Tile Grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	12/09/2022	White	3.00% Cellulose	78.00% Ca Carbonate 19.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 64-166 *062225136-0033*		**Description** Second Floor North Bathroom - Blue Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Tan		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Tan		100.00% Other	**None Detected**
Sample ID 64-167 *062225136-0034*		**Description** First Floor Men's Bathroom - Blue Ceramic Wall Tile Glue **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/09/2022	Tan		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	12/09/2022	Tan		100.00% Other	**None Detected**

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Initial report from: 12/09/2022 15:08:51

EMSL Analytical, Inc.
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062225136
Customer ID:	JCBR50
Customer PO:	
Project ID:	

Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Sample Receipt Date:	12/8/2022	Sample Receipt Time:	2:26 PM
Analysis Completed Date:	12/9/2022	Analysis Completed Time:	10:21 AM

Analyst(s):

Jimmy Encalada PLM NYS 198.1 Friable (26)

Michael Hartcorn PLM NYS 198.6 NOB (8)

Jordan Diaz TEM NYS 198.4 NOB (8)

Samples reviewed and approved by:

Daniel Clarke, Asbestos Laboratory Manager
or Other Approved Signatory

DRAFT

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469, NVLAP Lab Code 101048-10

Initial report from: 12/09/2022 15:08:51

OrderID: 062225823

062225823

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: Nassau County 2nd Police Precinct
ADDRESS: 7700 Jericho Turnpike, Woodbury NY 11797
DATE: 12/20/2022
CLIENT: JCB – 2nd Precinct
PROJECT #: 22-53344

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

SAMPLER'S NAME: Paul Fazio
SAMPLER'S SIGN:
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | (12 HOUR) | 6 HOUR | RUSH | OTHER
MANAGER: Fazio

SAMPLE #	HM #	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
168	65	Black Tar on Exterior Face Brick	2nd Floor @ Building Cavity on Face Brick	ASB
169	65	Black Tar on Exterior Face Brick	2nd Floor @ Building Cavity on Face Brick	ASB

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RECEIVED EMSL ANALYTICAL, INC CARLE PLACE, NY DEC 21 2022 12:53

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Paul Fazio		12/21/2022	1147			12-21-22	1237
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Sawyer Fazio	Sawyer Fazio	12/21/22	

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

Page 1 Of 1

EMSL Analytical, Inc.

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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062225823
Customer ID: JCBR50
Customer PO:
Project ID:

Attention: Paul Fazio
J.C. Broderick & Associates
1775 Expressway Drive North, Suite 1
Hauppauge, NY 11788

Phone: (631) 584-5492
Fax:
Received Date: 12/21/2022 12:37 PM
Analysis Date: 12/21/2022
Collected Date: 12/20/2022

Project: Nassau County 2nd Police Precinct, 7700 Jericho Turnpike, Woodbury, NY 11797, JCB-2nd Precinct #22-53344

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 65-168 *062225823-0001*		**Description**	2nd Floor @ Building Cavity on Face Brick - Black Tar on Exterior Face Brick		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/21/2022	Black	None	92.10% Other	**7.90% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 65-169 *062225823-0002*		**Description**	2nd Floor @ Building Cavity on Face Brick - Black Tar on Exterior Face Brick		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	12/21/2022	Black	None	92.40% Other	**7.60% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**

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Initial report from: 12/20/2022 21:40:12

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
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http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062225823
Customer ID:	JCBR50
Customer PO:	
Project ID:	

Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Sample Receipt Date:	12/21/2022	Sample Receipt Time:	12:37 PM
Analysis Completed Date:	12/21/2022	Analysis Completed Time:	8:56 PM

Analyst(s):

Sawyer Fries

Sawyer Fries PLM NYS 198.6 NOB (2)

Samples reviewed and approved by:

Daniel Clarke, Asbestos Laboratory Manager
or Other Approved Signatory

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EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469, NVLAP Lab Code 101048-10

Initial report from: 12/20/2022 21:40:12

Laboratory Certifications

DRAFT

J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2023
Issued April 01, 2022

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. DANIEL CLARKE
EMSL ANALYTICAL, INC.
528 MINEOLA AVE.
CARLE PLACE, NY 11514

NY Lab Id No: 11469

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual
	EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual
Asbestos-Vermiculite-Containing Material	Item 198.8 of Manual
Lead in Dust Wipes	EPA 7000B
Lead in Paint	EPA 7000B

Sample Preparation Methods

EPA 3051A

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Serial No.: 64680

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

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NVLAP LAB CODE: 101048-10

EMSL Analytical, Inc.

Carle Place, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2022-07-01 through 2023-06-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EMSL Analytical, Inc.
528 Mineola Ave.
Carle Place, NY 11514
Mr. Daniel Clarke
Phone: 516-997-7251
Email: dclarke@emsl.com
http://www.emsl.com

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ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 101048-10

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

For the National Voluntary Laboratory Accreditation Program

JCB
Certifications

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J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

New York State – Department of Labor
Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

J.C. Broderick & Associates Inc.

1775 Expressway Drive No.

Hauppauge, NY 11788

FILE NUMBER: 99-0503
LICENSE NUMBER: 28731
LICENSE CLASS: RESTRICTED
DATE OF ISSUE: 04/26/2022
EXPIRATION DATE: 05/31/2023

Duly Authorized Representative – Brendan Broderick:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

DRAFT

Amy Phillips, Director
For the Commissioner of Labor

SH 432 (8/12)

J.C. BRODERICK & ASSOCIATES, INC.
1775 EXPRESSWAY DRIVE NORTH
HAUPPAUGE, NEW YORK 11788
(631) 584-5492 Fax: (631) 584-3395

NAME	CERTIFICATION NUMBER	ASBESTOS CERTIFICATIONS	EXPIRATION MONTH	EXPIRATION YEAR
Ahmed, Syed	21-08355	Air Sampling Technician	April	2023
Albashir, Dania	21-08875	Air Sampling Technician	January	2023
Anderson, Chris	22-08807	Air Sampling Technician	June	2023
Barkan, Malcolm	98-22805	Project Designer	December	2022
Barnoski, Dakota	21-08356	Air Sampling Technician	July	2022
Balsam, Jared	22-08806	Air Sampling Technician	April	2023
Benitez, Henry	22-09081	Air Sampling Technician	April	2023
Bertrand, Wilfrid	04-01818	Air Sampling Technician	August	2023
Bertrand, Wilfrid	04-01818	Project Monitor	August	2023
Bertrand, Wilfrid	04-01818	Inspector	August	2022
Billan, Julian	22-09086	Air Sampling Technician	July	2023
Bogdan, Katerina	21-08354	Air Sampling Technician	February	2023
Bolognini, Danielle	19-11156	Inspector	November	2023
Bolognini, Danielle	19-11156	Air Sampling Technician	November	2023
Bolognini, Danielle	19-11156	Project Monitor	November	2023
Boniface, Jarett	17-28399	Project Monitor	October	2023
Boniface, Jarett	17-28399	Air Sampling Technician	October	2023
Boniface, Jarett	17-28399	Inspector	October	2023
Bracamonte, Jesus	07-11498	Inspector	September	2022
Bracamonte, Jesus	07-11498	Air Sampling Technician	September	2022
Bracamonte, Jesus	07-11498	Project Monitor	September	2022
Broderick, Brendan	93-11994	Air Sampling Technician	August	2023
Broderick, Brendan	93-11994	Project Monitor	August	2023
Broderick, Brendan	93-11994	Inspector	August	2023
Broderick, Brendan	93-11994	Management Planner	August	2023
Broderick, Brendan	93-11994	Project Designer	August	2023
Broderick, Brendan	93-11994	Supervisor	August	2023
Broderick, Emily	17-36018	Air Sampling Technician	August	2023
Broderick, Emily	17-36018	Project Monitor	August	2023
Broderick, Emily	17-36018	Inspector	August	2023
Broderick, Liam	21-07886	Air Sampling Technician	December	2023
Broderick, Liam	21-07886	Project Monitor	December	2023
Broderick, Lynn	05-03861	Inspector	September	2023
Broderick, Lynn	05-03861	Supervisor	September	2022
Broderick, Lynn	05-03861	Air Sampling Technician	September	2023
Broderick, Lynn	05-03861	Air Sampling Technician	September	2022
Broderick, Sarah	21-07882	Air Sampling Technician	December	2022
Burzo, Nicolas	21-08886	Air Sampling Technician	July	2023
Burzo, Nicolas	21-08886	Project Monitor	July	2023
Buschman, Paul	21-07880	Air Sampling Technician	August	2023
Buschman, Paul	21-07880	Project Monitor	August	2023
Buschman, Paul	21-07880	Project Monitor	August	2023
Calderon, Erik	22-09085	Air Sampling Technician	April	2023
Cass, Jamie	19-10322	Air Sampling Technician	September	2023
Cass, Jamie	19-10322	Project Monitor	September	2023
Cass, Jamie	19-10322	Inspector	September	2023
Castelluzzo, Alina	21-08877	Air Sampling Technician	March	2023
Castelluzzo, Alina	21-08877	Project Monitor	March	2023
Castelluzzo, Alina	21-08877	Inspector	March	2023
Castillo, Gabriella	21-08349	Air Sampling Technician	May	2023
Castillo, Gabriella	21-08349	Project Monitor	May	2023
Chhaidan, Muhammad	21-08350	Air Sampling Technician	March	2022
Castillo, Gabriella	21-08349	Project Monitor	May	2023
Ciesluk, Paul	22-08804	Air Sampling Technician	July	2023

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NAME	CERTIFICATION NUMBER	ASBESTOS CERTIFICATIONS	EXPIRATION MONTH	EXPIRATION YEAR	
Cohen, Maksym	21-08888	Air Sampling Technician	February	2023	
Covington, Malaysha	DOH911928	Air Sampling Technician	October	2023	
Cohen, Mitchel	22-09108	Air Sampling Technician	November	2023	
Conte, Francesca	21-08347	Air Sampling Technician	February	2023	
Conway, Grace	22-08805	Air Sampling Technician	January	2023	
Coulter, Luke	21-08344	Air Sampling Technician	August	2023	
Criollo, Josue	20-07331	Air Sampling Technician	September	2022	
Crossley, Quinlan	22-08472	Air Sampling Technician	January	2023	
Crossley, Quinlan	22-08472	Project Monitor	January	2023	
Crowe, Savannah	20-07333	Air Sampling Technician	February	2023	
Crowe, Savannah	20-07333	Project Monitor	February	2023	
Crowe, Savannah	20-07333	Inspector	February	2023	
Dateno, Cody	22-09084	Air Sampling Technician	October	2023	
Drummond, Desrick	21-08345	Air Sampling Technician	February	2023	
Eden, Paul	09-12939	Inspector	March	2023	
Eden, Paul	09-12939	Management Planner	March	2023	
Eden, Paul	09-12939	Air Sampling Technician	March	2023	
Eden, Paul	09-12939	Project Monitor	March	2023	
Eid, Ryan	04-07665	Air Sampling Technician	October	2022	
Eid, Ryan	04-07665	Project Monitor	October	2022	
Eid, Ryan	04-07665	Inspector	October	2023	
Eid, Ryan	04-07665	Management Planner	October	2023	
Eid, Ryan	04-07665	Project Designer	October	2022	
Eid, Ryan	118732	Investigator	October	2022	
Eisenberg, Barbara	97-21941	Air Sampling Technician	May	2023	
Eisenberg, Barbara	97-21941	Project Monitor	May	2023	
Ezelius, Bryan	07-11505	Air Sampling Technician	August	2023	
Ezelius, Bryan	07-11505	Project Monitor	August	2023	
Ezelius, Bryan	07-11505	Project Designer	August	2023	
Ezelius, Bryan	07-11505	Inspector	August	2023	
Ezelius, Bryan	07-11505	Management Planner	August	2023	
Fazio, Paul	02-16230	Air Sampling Technician	September	2023	
Fazio, Paul	02-16230	Project Monitor	September	2023	
Fazio, Paul	02-16230	Inspector	September	2023	
Fazio, Paul	02-16230	Management Planner	September	2023	
Fazio, Paul	02-16230	Project Designer	September	2022	
Frantellizzi, Enrico	21-07936	Air Sampling Technician	January	2023	
Frevert, Grant	22-07773	Air Sampling Technician	July	2023	
Gatto, Libario	22-08498	Air Sampling Technician	April	2023	
Gatto, Libario	22-08498	Project Monitor	April	2023	
Gonzalez, Juan	07-09637	Inspector	September	2023	
Gonzalez, Juan	07-09637	Air Sampling Technician	September	2023	
Gonzalez, Juan	07-09637	Project Monitor	September	2023	
Goodman, Matthew	21-08889	Air Sampling Technician	July	2022	
Greve, George	13-02944	Inspector	November	2023	
Greve, George	13-02944	Management Planner	November	2023	
Greve, George	13-02944	Air Sampling Technician	November	2022	
Greve, George	13-02944	Project Monitor	November	2022	
Guarnieri, Kiera	22-07353	Inspector	May	2023	
Guarnieri, Kiera	22-07353	Project Monitor	May	2023	
Guarnieri, Kiera	22-07353	Air Sampling Technician	May	2023	
Gutierrez, Aaron	21-07934	Air Sampling Technician	October	2023	
Gutierrez, Aaron	21-07934	Project Monitor	October	2023	
Gwynn, Meghan	12-12633	Air Sampling Technician	April	2023	
Gwynn, Meghan	12-12633	Project Monitor	April	2023	
Gwynn, Meghan	12-12633	Inspector	April	2023	
Gwynn, Meghan	12-12633	Management Planner	April	2023	
Haupt, Theresa	21-08885	Air Sampling Technician	January	2023	
Hayden, Kelly	22-08810	Air Sampling Technician	July	2023	

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NAME	CERTIFICATION NUMBER	ASBESTOS CERTIFICATIONS	EXPIRATION MONTH	EXPIRATION YEAR	
Hayes, Griffin	859134	Air Sampling Technician	October	2022	
Hayes, Griffin	874375	Project Monitor	October	2022	
Hayes, Griffin	881382	Inspector	October	2022	
Heller, Rachel	22-08479	Project Monitor	August	2023	
Heller, Rachel	22-08479	Air Sampling Technician	August	2023	
Heneghan, Daniel	22-07770	Air Sampling Technician	April	2023	
Hill, Brendan	20-07081	Air Sampling Technician	August	2022	
Hill, Brendan	20-07081	Project Monitor	August	2022	
Hobert, Brianna	21-08884	Air Sampling Technician	October	2022	
Jabbie, Yusuf	22-08813	Air Sampling Technician	February	2023	
Islam, MD Rakib	DOH911925	Air Sampling Technician	June	2023	
Jackson, James	21-08871	Project Monitor	August	2023	
Jackson, James	21-08871	Air Sampling Technician	August	2023	
JCB COMPANY LICENSE	**28731**	**JCB COMPANY LICENSE**	**May**	**2023**	
Kasper, Alexander	21-08346	Air Sampling Technician	July	2023	
Kasper, Alexander	21-08346	Project Monitor	July	2023	
Kasper, Alexander	21-08346	Inspector	July	2023	
Kahn, Faizan Ahmed	DOH911927	Air Sampling Technician	December	2023	
Kraus, Kyra	21-07883	Air Sampling Technician	May	2023	
Kraus, Kyra	21-07883	Project Monitor	May	2023	
Kraus, Kyra	21-07883	Inspector	May	2023	
Larkins, Nathaniel	22-09082	Air Sampling Technician	January	2023	
Lee, Man Jung	22-07772	Air Sampling Technician	November	2023	
Lin, Felipe	22-07768	Air Sampling Technician	July	2023	
Lin, Jia Long	22-08780	Air Sampling Technician	August	2023	
Lombardo, Anthony	15-10406	Air Sampling Technician	June	2023	
Lombardo, Anthony	15-10406	Project Monitor	June	2023	
Lombardo, Anthony	15-10406	Inspector	June	2023	
Lombardo, Anthony	15-10406	Management Planner	June	2023	
Mangan, Kevin	22-08467	Air Sampling Technician	August	2023	
Mangan, Kevin	22-08467	Project Monitor	August	2023	
Manzella, Robert	06-09334	Project Designer	March	2023	
Manzella, Robert	06-09334	Air Sampling Technician	March	2023	
Manzella, Robert	06-09334	Project Monitor	March	2023	
Manzella, Robert	06-09334	Inspector	March	2023	
Manzella, Robert	14-7658	Investigator	March	2023	
Marmo, Charles	22-08811	Air Sampling Technician	September	2023	
Martin, Matthew	13-11255	Air Sampling Technician	May	2023	
Martin, Matthew	13-11255	Project Monitor	May	2023	
Martin, Matthew	13-11255	Inspector	May	2023	
Mayr, Ryan	21-08358	Air Sampling Technician	February	2023	
McClellan, Aidan	22-07775	Air Sampling Technician	August	2023	
McGuire, Edward	03-11174	Air Sampling Technician	September	2023	
McGuire, Edward	03-11174	Inspector	September	2023	
McGuire, Edward	03-11174	Project Designer	September	2023	
McGuire, Edward	03-11174	Management Planner	September	2023	
McGuire, Edward	03-11174	Project Monitor	September	2023	
McNamee, Aileen	18-53973	Air Sampling Technician	August	2023	
McNamee, Aileen	18-59373	Project Monitor	August	2023	
McNamee, Aileen	18-53973	Inspector	August	2023	
Merandi, Grace	22-07764	Air Sampling Technician	March	2023	
Meyers, Jack	22-07766	Air Sampling Technician	July	2023	
Michalowski, Lori	14-10261	Project Monitor	August	2023	
Michalowski, Lori	14-10261	Air Sampling Technician	August	2023	
Michalowski, Lori	14-10261	Inspector	August	2023	
Millinis, Robert	08-10206	Air Sampling Technician	June	2023	
Millinis, Robert	08-10206	Inspector	June	2023	
Millinis, Robert	08-10206	Project Monitor	June	2023	
Mills, Stephen	22-07776	Air Sampling Technician	May	2023	

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NAME	CERTIFICATION NUMBER	ASBESTOS CERTIFICATIONS	EXPIRATION MONTH	EXPIRATION YEAR	
Montgomery, Edesa	22-08781	Air Sampling Technician	September	2023	
Montoya, Anthony	20-06847	Air Sampling Technician	December	2022	
Montoya, Anthony	20-06847	Project Monitor	December	2022	
Montoya, Anthony	20-06847	Inspector	December	2022	
Mrozek, Jacek	94-18310	Inspector	May	2023	
Mrozek, Jacek	94-18310	Air Sampling Technician	May	2023	
Mrozek, Jacek	94-18310	Project Monitor	May	2023	
Mueller, Joseph	21-07887	Air Sampling Technician	October	2023	
Mueller, Joseph	21-07887	Project Monitor	October	2023	
Nath, Dinesh	21-08872	Air Sampling Technician	February	2023	
O'Keefe, Kelly	21-08351	Air Sampling Technician	October	2022	
Orlassino, Alexandria	20-07332	Air Sampling Technician	December	2023	
Orlassino, Alexandria	20-07332	Project Monitor	December	2023	
Orlassino, Alexandria	20-07332	Inspector	December	2023	
Ostroff, Evan	22-07774	Air Sampling Technician	April	2023	
Palacios, Steeven	DOH911926	Air Sampling Technician	April	2023	
Passafiume, Angelo	22-08809	Air Sampling Technician	September	2023	
Patel, Kunal	18-53552	Air Sampling Technician	June	2023	
Patel, Kunal	18-53552	Project Monitor	June	2023	
Peet, Justin	15-06656	Air Sampling Technician	April	2023	
Peet, Justin	15-06656	Inspector	April	2023	
Peet, Justin	15-06656	Project Monitor	April	2023	
Piotrowski, Krzysztof	10-16621	Air Sampling Technician	January	2023	
Piotrowski, Krzysztof	10-16621	Project Monitor	January	2023	
Piotrowski, Krzysztof	10-16621	Inspector	January	2023	
Piotrowski, Krzysztof	10-16621	Supervisor	January	2023	
Ricker, Tara	13-14302	Inspector	November	2023	
Ricker, Tara	13-14302	Management Planner	November	2023	
Ricker, Tara	13-14302	Air Sampling Technician	November	2023	
Ricker, Tara	13-14302	Project Monitor	November	2023	
Robinson, Evan	21-08892	Air Sampling Technician	February	2023	
Roldan, Jose	19-11158	Air Sampling Technician	July	2023	
Roldan, Jose	19-11158	Project Monitor	July	2023	
Roldan, Jose	19-11158	Inspector	July	2023	
Roscoe, Tatiana	22-07763	Air Sampling Technician	July	2023	
Santos, Richard	22-08468	Project Monitor	July	2023	
Santos, Richard	22-08468	Air Sampling Technician	July	2023	
Schaaf, Brian	21-08870	Air Sampling Technician	October	2022	
Sessa, Albert	22-07765	Air Sampling Technician	October	2023	
Silva, Roberto	22-08808	Air Sampling Technician	October	2023	
Smalls, Daniel	18-53544	Air Sampling Technician	February	2023	
Smalls, Daniel	18-53544	Project Monitor	February	2023	
Smalls, Daniel	18-53544	Inspector	February	2023	
Steele, Kelly	21-08893	Air Sampling Technician	October	2022	
Stehlik, Scott	21-07881	Air Sampling Technician	December	2022	
Stoehr, Christopher	17-34896	Air Sampling Technician	May	2023	
Stoehr, Christopher	17-38496	Project Monitor	May	2023	
Stoehr, Christopher	17-34896	Inspector	May	2023	
Streit, Michael	21-08895	Air Sampling Technician	December	2022	
Sugumele, Nick	22-07767	Air Sampling Technician	May	2023	
Thomas, Milton	22-07769	Air Sampling Technician	May	2023	
Todzia, Erin	18-54080	Air Sampling Technician	April	2023	
Todzia, Erin	18-54080	Project Monitor	April	2023	
Todzia, Erin	18-54080	Inspector	April	2023	
Toney, Ronald	17-32870	Air Sampling Technician	August	2023	
Toney, Ronald	17-32870	Project Monitor	August	2023	
Toney, Ronald	17-32870	Inspector	August	2023	
Trapani, Cole	21-08891	Air Sampling Technician	March	2023	
Urban, Matthew	14-10951	Air Sampling Technician	May	2023	

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NAME	CERTIFICATION NUMBER	ASBESTOS CERTIFICATIONS	EXPIRATION MONTH	EXPIRATION YEAR	
Urban, Matthew	14-10951	Project Monitor	May	2023	
Urban, Matthew	14-10951	Inspector	May	2023	
Valmond, Rudy	93-05790	Air Sampling Technician	January	2023	
Valmond, Rudy	93-05790	Project Monitor	January	2023	
Valmond, Rudy	93-05790	Inspector	January	2023	
Victome, David	21-08357	Air Sampling Technician	August	2022	
Vigliotti, Dante	21-08890	Air Sampling Technician	February	2023	
Watson, Aiden	22-09083	Air Sampling Technician	July	2023	
Wheeler, Amber	21-08874	Air Sampling Technician	January	2023	
Wilson, John	17-32873	Air Sampling Technician	August	2023	
Wilson, John	17-32873	Project Monitor	August	2023	
Wilson, John	17-32873	Inspector	August	2023	
Xiao, Shangkun	19-11389	Air Sampling Technician	May	2023	
Xiao, Shangkun	19-11389	Project Monitor	May	2023	
Xiao, Shangkun	19-11389	Inspector	May	2023	
Yuan, Fiona	22-08812	Air Sampling Technician	April	2023	
Zhao, Weiman Rebekah	22-09087	Air Sampling Technician	June	2023	

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