

# **SPECIFICATIONS**

**OCEAN COUNTY COLLEGE  
1 COLLEGE DRIVE  
TOMS RIVER, NJ 08754**

**CONFERENCE CENTER / RENOVATION**



## **JRS ARCHITECT, P.C.**

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November 7, 2019  
Bid Documents

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**SECTION 011000 - SUMMARY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Project Identification: Ocean County College  
Building # 10 Conference Center
- B. Architect's Name: JRS Architect
- C. Engineer's Name: T&M Associates
- D. Project Summary:

**Building #10 Conference Center**, the existing bookstore will be removed and replaced with a new conference center, and a new unisex ADA restroom added. The rest of the building will have new ceilings and led lighting. The existing conference room will receive all new finishes. All of the building interiors will be repainted. Building 10 was previously served by local boilers located in Building 10 and a local chiller located in Building 9. The existing boilers, pumps, expansion tanks, etc. are being removed as part of this project, as well as connections to the Building 9 chiller.

The existing horizontal air-handling units, fan coil units, and exhaust fans located above the ceiling are being replaced with one centralized variable air volume rooftop unit to serve the entire facility. Variable air volume boxes with hot water heating coils are being installed to serve individual zones. Cabinet heaters and exhaust fans are being replaced, and a new air curtain is being installed at the entrance.

Plumbing system modifications are required to support the addition of the new toilet room. Electrical modifications as required to support the architectural and mechanical renovations.

- E. Particular Project Requirements:
  - 1. Existing site conditions and future work for adjacent buildings shall be reviewed and coordinated.
  - 2. Hazardous waste or asbestos work by contractor shall be completed prior to start of demolition.
- F. Permits and Fees: Apply for and obtain permits. Copies to Architect.
- G. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.
- H. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
- I. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval.
- J. Coordination:
  - 1. Coordinate the work of all trades.
  - 2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.

**SECTION 011000 - SUMMARY**

3. Verify location of utilities and existing conditions.
- K. Installation Requirements, General:
1. Inspect substrates and report unsatisfactory conditions in writing.
  2. Do not proceed until unsatisfactory conditions have been corrected.
  3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
  4. Install materials in exact accordance with manufacturer's instructions and approved submittals.
  5. Install materials in proper relation with adjacent construction and with proper appearance.
  6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.
  7. Refer to additional installation requirements and tolerances specified under individual specification sections.
- L. Limit of Use: Limit use of work as indicated. Keep driveways and entrances clear.
- M. Existing Construction: Maintain existing building in a weathertight condition. Repair damage caused by construction operations. Protect building and its occupants.
- N. Definitions:
1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
  2. Approved: Acceptance of item submitted for approval. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Approved' in General and Supplementary Conditions.
  3. Match Existing: Match existing as acceptable to the Owner.
- O. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.
- P. Writing Style: Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

**1.03 OWNER OCCUPANCY**

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

**1.05 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner:
  1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Existing building spaces may not be used for storage.

**SECTION 011000 - SUMMARY**

- D. Utility Outages and Shutdown:
  - 1. Prevent accidental disruption of utility services to other facilities.
- 2 PRODUCTS - Not applicable to this Section
- 3 EXECUTION - Not applicable to this Section

END OF SECTION

**SECTION 013000 - ADMINISTRATIVE REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Construction progress schedule.
- D. Progress photographs.
- E. Submittals for review, information, and project closeout.
- F. Number of copies of submittals.
- G. Submittal procedures.

**1.2 RELATED SECTIONS – NOT USED**

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION**

**3.1 PRECONSTRUCTION MEETING**

- A. Architect or owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Engineer
  - 4. Contractor.
- C. Agenda:
  - 1. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  - 2. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 3. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

**3.2 PROGRESS MEETINGS**

- A. Make arrangements for meetings, prepare updated schedules and look aheads with copies for participants, preside at meetings.
- B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- C. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Maintenance of progress schedule.
  - 7. Corrective measures to regain projected schedules.
  - 8. Planned progress during succeeding work period.
  - 9. Maintenance of quality and work standards.



**SECTION 013000 - ADMINISTRATIVE REQUIREMENTS**

10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to Work.

**3.3 CONSTRUCTION PROGRESS SCHEDULE**

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. Submit updated schedule with each Application for Payment.

**3.4 PROGRESS PHOTOGRAPHS**

- A. Photography Type: Digital; electronic files.
- B. Provide a minimum of 10 digital photographs each week of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.
- C. Views: Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format.
  1. Delivery Medium: email.
  2. File Naming: Include project identification, date and time of view, and view identification.
  3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

**3.5 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.
  3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. The General Contractor is responsible to review submittals prior to issuing to the Architect or Engineer for review.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800.

**3.6 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  1. Design data.
  2. Certificates.
  3. Test reports.
  4. Inspection reports.
  5. Manufacturer's instructions.
  6. Manufacturer's field reports.
  7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

**3.7 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
  1. Project record As-Built documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.

**SECTION 013000 - ADMINISTRATIVE REQUIREMENTS**

5. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

**3.8 NUMBER OF COPIES OF SUBMITTALS**

A. Documents for Review:

All submittals shall be submitted electronically via email in pdf format. Submit physical samples for color, texture and size shall be adequate in size to represent the finish appearance.

When hard copies are required use the following guidelines:

1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus one copy that will be retained by Architect.
2. Larger Sheets, Not Larger Than 36 x 48 inches: Submit the number of opaque reproductions that Contractor requires, plus one copy that will be retained by Architect.

B. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect. Retained samples will not be returned to Contractor unless specifically so stated.

**3.9 SUBMITTAL PROCEDURES**

A. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

D. Deliver submittals to Architect at business address. Email is acceptable for non-physical samples.

E. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

F. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

G. Provide space for Contractor Engineer and Architect review stamps.

H. When revised for resubmission, identify all changes made since previous submission.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

**END OF SECTION**

**SECTION 013113 – PROJECT COORDINATION**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Construction mobilization.
- B. Coordination drawings.
- C. Contractor Regulations

**1.02 CONSTRUCTION MOBILIZATION**

- A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.

**1.03 COORDINATION DRAWINGS**

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect/Engineer.

**1.04 CONTRACTOR REGULATIONS**

- A. Determine the coordination, policies and procedures with the client Agency with respect to parking, material staging, and storage areas, use of Client Agency utilities, allowable hours of construction, the need and location of construction and storage trailers, etc.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

END OF SECTION

**SECTION 013300 – SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Submittal procedures.
- B. Proposed Products list.
- C. Product Data.
- D. Shop Drawings.
- E. Samples.
- F. Design data.
- G. Certificates.
- H. Manufacturer's instructions.

**1.02 SUBMITTAL PROCEDURES**

- A. Transmit each submittal with Architect/Engineer accepted form.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite the Project, and deliver to Architect/Engineer at business address. Coordinate submission of related items.
- E. For each submittal for review, allow 14 days excluding delivery time to and from the Contractor.
- F. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- G. Provide space for Contractor and Architect/Engineer review stamps.
- H. When revised for resubmission, identify all changes made since previous submission.
- I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- J. Submittals not requested will not be recognized or processed.

**1.03 PROPOSED PRODUCTS LIST**

- A. Within 14 days after date of NTP, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

013300-1

**SECTION 013300 – SUBMITTAL PROCEDURES**

- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

**1.04 PRODUCT DATA**

- A. Product Data For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article in General Conditions
- B. Product Data For Information:
  - 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- C. Product Data For Project Close-out:
  - 1. Submitted for the Owner's benefit during and after project completion.
- D. Submit the number of copies which the Contractor requires, plus two copies which will be retained by the Architect/Engineer.
- E. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- F. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- G. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in General Conditions.

**1.05 SHOP DRAWINGS**

- A. Shop Drawings For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES in General Conditions.
- B. Submit the number of opaque reproductions which Contractor requires, plus two copies which will be retained by Architect/Engineer.

**1.06 SAMPLES**

- A. Samples For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES in General Conditions.
- B. Samples For Information:
  - 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- C. Samples For Selection:

**SECTION 013300 – SUBMITTAL PROCEDURES**

1. Submitted to Architect/Engineer for aesthetic, color, or finish selection.
2. Submit samples of finishes [from the full range of manufacturers' standard colors, in custom colors selected, textures, and patterns for Architect/Engineer selection.
3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in General Conditions.

D. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

E. Include identification on each sample, with full Project information.

F. Submit the number of samples specified in individual specification sections; one of which will be retained by Architect/Engineer.

G. Reviewed samples which may be used in the Work are indicated in individual specification sections.

H. Samples will not be used for testing purposes unless specifically stated in the specification section.

**1.07 DESIGN DATA**

A. Submit for the Architect/Engineer's knowledge as contract administrator or for the Owner.

B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

**1.08 CERTIFICATES**

A. When specified in individual specification sections, submit certification by the manufacturer, installation/application Subcontractor, or the Contractor to Architect/Engineer, in quantities specified for Product Data.

B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

**SECTION 013300 – SUBMITTAL PROCEDURES**

**1.09 MANUFACTURER'S INSTRUCTIONS**

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

END OF SECTION

**SECTION 015600 - TEMPORARY BARRIERS AND ENCLOSURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Temporary construction barriers, enclosures and passageways.
  - 1. Dust and debris barriers.
  - 2. Security barriers.
  - 3. Temporary chain link fencing.
- B. Protection of completed Work.
- C. Removal of construction facilities and temporary controls.

**1.3 RELATED SECTIONS**

- A. Section 01100 - Summary of the Work: Contractor's use of site and premises
- B. General Conditions – Article 4 – The Contractor

**1.4 PROTECTION OF EXISTING CONDITIONS**

- A. Protection of Adjacent Facilities: Contractor shall restrict Work to limits indicated on the Drawings and as specified in Section 01 1100 - Summary of the Work: Protect existing, adjacent facilities from damage, including soiling and debris accumulation.
- B. Protection of Existing Furniture, Fixtures and Equipment: As applicable, provide temporary enclosures, barriers and covers to protect existing furniture, fixtures and equipment remaining in Project area during construction.

**1.5 MAINTENANCE OF CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

- A. Maintenance: Use all means necessary to maintain temporary barriers and enclosures in proper and safe condition throughout progress of the Work.
- B. Replacement: In the event of loss or damage, promptly restore temporary barriers and enclosures by repair or replacement at no change in the Contract Sum or Contract Time.

**1.6 TEMPORARY BARRIERS, ENCLOSURES AND PASSAGEWAYS**

- A. Temporary Barriers, General: Provide temporary fencing, barriers and guardrails as necessary to provide for public safety, to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
  - 1. Refer to temporary fencing in the Drawings. Comply with requirements indicated.
  - 2. Note requirements for site areas during construction.
  - 3. Comply with applicable code requirements and authorities having jurisdiction, including industrial safety regulations. Review requirements with OCC Representative.



**SECTION 015600 - TEMPORARY BARRIERS AND ENCLOSURES**

4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
- B. Temporary Closures: Provide temporary closures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather-tight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate closures with ventilating and material drying or curing requirements to avoid dangerous conditions and effects such as mold.
- C. Temporary Partitions: Erect and maintain temporary partitions and temporary closures to limit dust and dirt migration, including migration into existing facilities, to separate areas from fumes and noise and to maintain fire-rated separations.
1. Dust barriers: Construct dustproof, floor-to-ceiling partitions of not less than nominal 4-inch (100-mm) studs, 2 layers of 3-mil (0.07-mm) polyethylene sheets, inside and outside temporary enclosure.
    - a. Overlap and tape full length of joints.
    - b. Include 5/8-inch thick gypsum board at temporary partitions serving as noise barrier.
    - c. Insulate partitions to minimize noise transmission to adjacent occupied areas.
    - d. Seal joints and perimeter of temporary partitions.
  2. Dust barrier passages: Where passage through dust barrier is necessary, provide gasketed doors or heavy plastic sheets that effectively prevent air passage.
    - a. Construct a vestibule and airlock at each entrance to temporary enclosure with not less than 48 inches (1219 mm) between doors.
    - b. Maintain water-dampened foot mats in vestibule where passage leads to existing occupied spaces.
    - c. Equip doors with security locks.
  3. Fire-rated temporary partitions: Maintain fire-rated separations, including corridor walls and occupancy separations, by construction of stud partitions with gypsum board faces.
    - a. Construction details shall comply with recognized time-rated fire-resistive construction. Typically, 1-hour rated partitions shall be 2x4 wood studs at 16-inches on center or 3-1/2 inch metal studs at 16-inches on center, with 5/8-inch thick Type X gypsum board at both faces, with joints filled, taped and topped.
    - b. Seal partition perimeters with acceptable fire stopping and smoke seal materials.
    - c. Construct fire-rated temporary partitions whenever existing time-rate fire-resistive construction is removed for 12 hours or more.
- D. Temporary Roof Protection: Maintain roof protection around areas of removals and new work and provide protected pathways.
- a. Temporary Protection Materials:
    - 1) Expanded Polystyrene (EPS) Insulation: ASTM C578.
    - 2) Plywood: NIST DOC PS 1, Grade CD Exposure 1.
    - 3) Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.All panels shall be properly weighted to avoid blow-off, utilize sand bags or similar.
- E. Temporary Floor Protection: Protect existing floors from soiling and damage.
4. Ram Board: Model # RB 48-100 Ram Board as manufactured by Ram Board. Heavy-duty temporary and reusable floor and wall protection.
    - a. Standards Compliance: FSC certified. Recycled and recyclable materials.

**SECTION 015600 - TEMPORARY BARRIERS AND ENCLOSURES**

- b. Wall Guard Feature: Fold lines allowing corner, horizontal and vertical wall protection. a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.
  - c. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
  - d. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue. Ram Board Plus tape isn't breathable.
  - e. Spill Guard Technology: Provides added protection against water, paint, mud, 01560-4 and more.
  - f. Roll Dimensions (W x L): 48 in x 100 ft (1219 mm x 30.5 m). 400 sq ft (37.1 sq m).
2. Vapor-Cure Tape: Model # RB VCT 3-108 as manufactured by Ram Board. Used to cover Ram Board seams which prevents tape lines.
- a. Performance: Allows vapors and moisture to escape from concrete, glue down floors, stained floors, epoxy floors, refinished floors, vinyl composition tile, and most other floor types.
  - b. Dimensions (W x L): 3 in x 108 ft (76 mm x 32.9 m).
  - c. Rolls per Box: 16.
3. Edge Tape: Model #RB ET 2.5-180 as manufactured by Ram Board. Used to secure Ram Board Temporary Floor Protection edges to flooring or wall surfaces.
- a. Performance: Easy Release, low tack tape for up to 14 days. Grips tightly to Ram Board while easy release on flooring surfaces up to 14 days.
5. Provide floor mats to clean dust from shoes.
- F. Landscape Barriers: Provide barriers around trees and plants designated to remain.
- 1. Locate barriers as directed outside of drip lines of trees and plants.
  - 2. Protect entire area under trees against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.
  - 3. Contractor shall pay all costs to restore trees and plants within barriers that are damaged by construction activities. Restoration shall include replacement with plant materials of equal quality and size. Costs shall include all fines, if any, levied by authorities having jurisdiction.
- G. Weather Closures: Provide temporary weather-tight closures at exterior openings to prevent intrusion of water, to create acceptable working conditions, to protect completed Work and to maintain temporary heating, cooling and ventilation. Provide access doors with self-closing hardware and locks.
- H. Temporary Access, Passage and Exit Ways: Construct temporary stairs, ramps, and covered walkways, with related doors, gates, closures, guardrails, handrails, lighting and protective devices, to maintain access and exit ways to existing facilities to remain operational.
- 1. Design and location of temporary construction shall be by Contractor, subject to review by OCC Representative and authorities having jurisdiction.
  - 2. Provide temporary lighting, illuminated interior exit signage, non-illuminated directional and instructional signage, and temporary security alarms for temporary exits and exit passageways.
  - 3. Temporary measures shall suit and connect to existing building systems and shall be approved by OCC Representative and authorities having jurisdiction.

**SECTION 015600 - TEMPORARY BARRIERS AND ENCLOSURES**

**1.7 REMOVAL OF TEMPORARY BARRIERS AND ENCLOSURES**

- A. Removal of Temporary Barriers and Enclosures: Unless otherwise mutually agreed by OCC Representative and Contractor, remove temporary materials, equipment, services, and construction prior to Contract Completion review.
  
- B. Cleaning and Repairs: Clean and repair damage, soiling and marring caused by installation or use of temporary barriers and enclosures.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

END OF SECTION

**SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 QUALIFICATIONS**

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

**1.02 PROJECT CONDITIONS**

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

**PART 2 PRODUCTS**

**2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

**3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

**3.03 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

**SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS**

- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations;
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

**3.04 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

**3.05 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
  - 1. Complete the work.
  - 2. Fit products together to integrate with other work.
  - 3. Provide openings for penetration of mechanical, electrical, and other services.
  - 4. Match work that has been cut to adjacent work.
  - 5. Repair areas adjacent to cuts to required condition.
  - 6. Repair new work damaged by subsequent work.
  - 7. Remove samples of installed work for testing when requested.
  - 8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- I. Patching:

**SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS**

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

**3.06 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

**3.07 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

**3.08 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

**3.09 FINAL CLEANING**

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage

**SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS**

Systems.

- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

**3.10 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

**END OF SECTION**

**SECTION 017329 – CUTTING AND PATCHING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements and limitations for cutting and patching of Work.

**1.02 SUBMITTALS**

- A. Submit written request in advance of cutting or alteration which affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
- B. Include in request:
  - 1. Identification of Project.
  - 2. Location and description of affected Work.
  - 3. Necessity for cutting or alteration.
  - 4. Description of proposed Work and Products to be used.
  - 5. Alternatives to cutting and patching.
  - 6. Effect on work of Owner or separate Contractor.
  - 7. Written permission of affected separate Contractor.
  - 8. Date and time work will be executed.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Primary Products: Those required for original installation.
- B. Product Substitution: For any proposed change in materials, submit request for substitution.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, assess conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

**3.02 PREPARATION**

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.



**SECTION 017329 – CUTTING AND PATCHING**

- C. Maintain excavations free of water.

**3.03 CUTTING**

- A. Execute cutting and fitting to complete the Work.
- B. Uncover work to install improperly sequenced work.
- C. Remove and replace defective or non-conforming work.
- D. Remove samples of installed work for testing when requested.
- E. Provide openings in the Work for penetration of mechanical and electrical work.
- F. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

**3.04 PATCHING**

- A. Execute patching to complement adjacent Work.
- B. Fit Products together to integrate with other Work.
- C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- E. Restore work with new Products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to full thickness of the penetrated element.
- H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

**PART 1 GENERAL**

**1.01 WASTE MANAGEMENT REQUIREMENTS**

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.
- E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
  - 1. Aluminum and plastic beverage containers.
  - 2. Corrugated cardboard.
  - 3. Wood pallets.
  - 4. Clean dimensional wood.
  - 5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 1000 - Site Clearing for use options.
  - 6. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
  - 7. Bricks: May be used on project if whole, or crushed and used as landscape cover, sub-base material, or fill.
  - 8. Concrete masonry units: May be used on project if whole, or crushed and used as sub-base material or fill.
  - 9. Precast concrete panels: May be used for erosion control or landscape features.
  - 10. Asphalt paving: May be recycled into paving for project.
  - 11. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
  - 12. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (<http://flooring.dupont.com>) and Interface ([www.interfaceinc.com](http://www.interfaceinc.com)) conduct reclamation programs.
- F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- H. The following sources may be useful in developing the Waste Management Plan:
  - I. Methods of trash/waste disposal that are not acceptable are:
    - 1. Burning on the project site.
    - 2. Burying on the project site.
    - 3. Dumping or burying on other property, public or private.
    - 4. Other illegal dumping or burying.
  - J. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: List of items to be salvaged from the existing building for relocation in project or for Owner.

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

- B. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- C. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- D. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- E. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
- F. Section 31 1000 - Site Clearing: Handling and disposal of land clearing debris.

**1.03 DEFINITIONS**

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit Landfill Alternatives Proposal, Waste Management Plan, and Waste Disposal Reports in accordance with procedures specified in Section 01 3329.

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

- C. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
1. Submit to Architect for Owner's review and approval.
  2. If Owner wishes to implement any cost alternatives, the Contract Price will be adjusted as specified elsewhere.
  3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
  4. Describe as many alternatives to landfilling as possible:
    - a. List each material proposed to be salvaged, reused, or recycled.
    - b. List the proposed local market for each material.
    - c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.
- D. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.
- E. Waste Management Plan: Include the following information:
1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
  2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
  3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
  4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
  5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
  6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- F. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
  2. Submit Report on a form acceptable to Owner.
  3. Landfill Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
    - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  4. Incinerator Disposal: Include the following information:
    - a. Identification of material.

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

- b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
- c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
- d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
  - a. Identification of material, including those retrieved by installer for use on other projects.
  - b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
  - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
  - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
  - a. Identification of material and how it was used in the project.
  - b. Amount, in tons or cubic yards (cubic meters).
  - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

**PART 3 EXECUTION**

**2.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 01 1000 for list of items to be salvaged from the existing building for relocation in project or for Owner.
- B. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- C. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
- D. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.
- E. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

**2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
  1. Pre-bid meeting.
  2. Pre-construction meeting.
  3. Regular job-site meetings.

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. Provide containers as required.
  - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

**SECTION 02411913 – SELECTIVE BUILDING DEMOLITION**

**GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Removal of designated building construction, equipment, and fixtures.
- B. Related Sections:
  - 1. Division 01 – General Conditions.

**1.2 SUBMITTALS**

- A. Submittals for Review:
  - 1. Shop Drawings: Indicate areas for demolition, removal sequence and location of salvageable items, and location and construction of temporary work.

**1.3 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for demolition work, safety of structure, and dust control.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Conform to applicable codes when hazardous or contaminated materials are discovered.
- E. Do not close or obstruct exits.
- F. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

**1.4 PROJECT CONDITIONS**

- A. Minimize interference with streets, walks, public right-of-ways, and adjacent facilities.
- B. If hazardous materials are discovered, other than described herein or noted on drawings, notify Architect and await instructions.
- C. If any of the following conditions are encountered, cease work immediately, notify Architect, and await instructions:
  - 1. Structure is in danger of movement or collapse.
  - 2. Materials or conditions encountered differ from those designated in the Contract Documents.

**PART 2 - PRODUCTS**

Not used

**SECTION 02411913 – SELECTIVE BUILDING DEMOLITION**

**PART 3- EXECUTION**

**3.1 PREPARATION**

- A. Erect temporary partitions, barricades, warning devices, and controls where required.
- B. Provide protective coverings for construction designated to remain.

**3.2 DEMOLITION**

- A. Remove existing construction to extent indicated on contract drawings and as necessary to complete new work. Do not remove more than is necessary to allow for new construction.
- B. Do not damage work designated to remain.
- C. Minimize noise and spread of dirt and dust.
- D. Assign work to trades skilled in procedures involved.
- E. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.
- F. Store items designated to remain property of Owner where directed by Owner.
- G. Remove and dispose of waste materials off site.

**3.3 UTILITY SERVICES**

- A. Maintain existing utilities indicated to remain in service and protect against damage during demolition operations. Extent of electrical and mechanical utilities to be removed as shown on Contract Documents.

**End of Section**



**SECTION 051200 - STRUCTURAL STEEL**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Structural shapes.
  - 2. Channels and angles.
  - 3. Structural plates and bars.
  - 4. Fasteners, connectors, and anchors.

1.02 RELATED WORK

- A. Structural Steel Framing:
  - 1. Section 055000 – Metal Fabrications.

1.03 REFERENCES

- A. American Institute of Steel Construction:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
  - 4. AISC Seismic Provisions for Structural Steel Buildings.
- B. ASTM International:
  - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 5. ASTM A193 - Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service.
  - 6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - 7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - 8. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
  - 9. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
  - 10. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
  - 11. ASTM A514 - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
  - 12. ASTM A529 - Standard Specification for High-Strength Carbon-Manganese Steel of

Structural Quality.

13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
14. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
15. ASTM A992 - Standard Specification for Structural Steel Shapes.
16. ASTM E94 - Standard Guide for Radiographic Examination.
17. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
18. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
19. ASTM E709 - Standard Guide for Magnetic Particle Examination.
20. ASTM F436 - Standard Specification for Hardened Steel Washers.
21. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
22. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
23. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

C. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.

D. Research Council on Structural Connections:

1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

E. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Paint.
3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
4. SSPC SP 3 - Power Tool Cleaning.
5. SSPC SP 6 - Commercial Blast Cleaning.
6. SSPC SP 10 - Near-White Blast Cleaning.

#### 1.04 SUBMITTALS

A. Submittal Procedures: Requirements for submittals as per the Information for Bidders and the General Conditions.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Connections.
3. Cambers.
4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.

- D. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with the following:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
  - 3. AISC Seismic Provisions for Structural Steel Buildings.
  - 4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
  - 5. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 6. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
- B. Perform Work in accordance with State of NJ Uniform Construction Code standards.

**1.06 QUALIFICATIONS**

- A. Fabricator: Company specializing in performing Work of this section with minimum 3 years experience with the following current AISC Certification:
  - 1. Standard Steel Building Structures (STD).
- B. Erector: Company specializing in performing Work of this section with minimum 3 years experience with the following current AISC Certification:
  - 1. Certified Steel Erector (CSE).
- C. Shop Painter: Company specializing in performing Work of this section with minimum 3 years experience with the following current AISC Certification:
  - 1. Sophisticated Paint Endorsement - Enclosed (P1).
  - 2. Sophisticated Paint Endorsement - Covered (P2).
  - 3. Sophisticated Paint Endorsement - Outside (P3).
- D. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months.

**1.07 COORDINATION**

- A. Administrative Requirements: Requirements for coordination as per the Information for Bidders and the General Conditions.

**PART 2 - PRODUCTS**

**2.01 STRUCTURAL STEEL**

- A. Structural W and WT-Shapes: ASTM A992; Grade 50.

- B. Channels and Angles: ASTM A36.
- C. Structural Plates and Bars: ASTM A36.
- D. Pipes: ASTM A53; Grade B.

**2.02 FASTENERS, CONNECTORS, AND ANCHORS**

- A. High Strength Bolts: ASTM A325; Type 1
  - 1. Finish: Hot-dipped galvanized.
- B. Nuts: ASTM A563 heavy hex type.
  - 1. Finish: Hot-dipped galvanized.
- C. Washers: ASTM F436; Type 1, circular
  - 1. Finish: Hot-dipped galvanized.
- D. Anchor Rods: ASTM A325 or approved equivalent.
  - 1. Shape: Nut and Washer Assembly.
  - 2. Plate Washers: ASTM A36.

**2.03 WELDING MATERIALS**

- A. Welding Materials: AWS D1.1; type required for materials being welded.

**2.04 ACCESSORIES**

- A. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

**2.05 FABRICATION**

- A. Space shear stud connectors as indicated on the Drawings.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.

**2.06 FINISH**

- A. Prepare structural component surfaces in accordance with SSPC SP 3.

**2.07 SOURCE QUALITY CONTROL AND TESTS**

- A. Quality Requirements: Testing, inspection and analysis requirements as per the Information for Bidders and the General Conditions.

- B. Shop-test bolted and welded connections as specified for field quality control tests.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Administrative Requirements: Verification of existing conditions before starting work as per the Information for Bidders and the General Conditions.
- B. Verify bearing surfaces are at correct elevation.
- C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

#### 3.02 PREPARATION

- A. Furnish templates for installation of anchor rods and embedment in concrete and masonry work.

#### 3.03 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components indicated on Drawings.
- C. Field connect members with threaded fasteners; torque to required resistance.
- D. Do not field cut or alter structural members without approval of Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

#### 3.04 ERECTION TOLERANCES

- A. Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: ¼ inch per story, non-cumulative.
- C. Maximum Offset from Alignment: 1/4 inch.

#### 3.05 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements.
- B. Bolted Connections: Inspect in accordance with AISC specifications.
  - 1. Visually inspect all bolted connections.
  - 2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
- C. Welding:

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1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
  2. Visually inspect all welds.
  3. Ultrasonic Inspection: ASTM E164; perform on all full-penetration welds.
- D. Correct defective bolted connections and welds.

END OF SECTION 051200

**SECTION 052100 – STEEL JOIST FRAMING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Open-web steel joists with bridging, attached seats, and anchors.
2. Loose bearing plates and anchor bolts for site placement.
3. Framed roof openings greater than 12 inches.

1.2 REFERENCE STANDARDS

A. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

B. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

C. Steel Joist Institute:

1. SJI K-1.1 - Standard Specification for Open Web Steel Joists, K-Series.

1.3 SUBMITTALS

A. Shop Drawings:

1. Indicate:
  - a. Standard designations, configuration, sizes, spacing, locations of joists, seat depth.
  - b. Joist coding, bridging, connections, and attachments.
  - c. Connection details.
  - d. Loading diagram.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for design of connections not detailed on Drawings.

- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- G. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, fabricator, erector, and licensed professional.
  - 2. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

#### 1.4 QUALITY ASSURANCE

- A. Comply with the following:
  - 1. SJI K-1.1

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Welders: AWS qualified within previous 12 months for employed weld types.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New Jersey.

#### 1.6 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. Open Web Joists Members: SJI Type K.
- B. Bolts:
  - 1. Comply with ASTM A325.
  - 2. Type:
    - a. 1; Plain heavy hex; structural.



- C. Anchor Rods:
  - 1. Description: ASTM F1554; Grade 55, weldable, ASTM A307; Grade A.
  - 2. Shape: Hooked.
- D. Structural Steel for Supplementary Framing and Joist Leg Extensions: Comply with ASTM A36.
- E. Welding Materials:
  - 1. Comply with AWS D1.1/D1.1M.
  - 2. Type: As required for materials being welded.
- F. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- G. Touchup Primer: Match shop primer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that bearing plates are set to required location and elevation.
- B. Verify that bearing surfaces are ready to receive joists.

#### **3.2 ERECTION**

- A. Erect and bear joists on supports.
- B. Allow for erection loads, and install sufficient temporary shoring and bracing to maintain framing safe, plumb, and in alignment.
- C. Bearing Plates:
  - 1. Coordinate placement of bearing plates in masonry construction for securing joist.
  - 2. After joist alignment and installation of framing, field weld joist seat to bearing plates.
- D. Frame roof openings greater than 18 inches with supplementary framing.
- E. Do not permit erection of decking until joists are braced, bridged and secured, or until completion of erection and installation of permanent bridging and bracing.
- F. Do not field-cut or alter structural members without approval of Architect/Engineer.
- G. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch.
- C. Maximum Offset from Indicated Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Section 01770 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Field-inspect members, connections, welds, and tightening of high-strength bolts in slip-critical connections.

END OF SECTION 052100

**SECTION 054000 - COLD-FORMED METAL FRAMING**

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work Included: Furnish all labor, materials, services and equipment necessary to complete all cold-formed steel framing work shown on the drawings and/or as specified herein.

B. Related Work Under Other Sections and Contracts:

1. Concrete - Section 033000.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data and installation instructions for each item of cold-formed metal framing and accessories.
2. Shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.
  - a. Include placing drawings for framing members showing size and gage designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.
  - b. Include cross sections, plans and/or elevations depicting component types and locations for each unique framing application.
  - c. Include connection details depicting fastener type, quantity, location and other information to assure proper installation.
  - d. Submit drawings depicting panel configurations, dimensions, components, locations and construction sequence.
  - e. All shop drawings shall be signed and sealed by the Contractor's Professional Structural Engineer.
3. The lightgauge members have not been designed and minimum sizes and thickness are shown on the drawings. The minimum sizes and thickness are based on Marino/Ware members. Members with equal or greater properties by other manufacturers are permitted.
4. The Contractor is responsible for the structural design of the cold-formed metal framing including connections, details, stiffeners, and any miscellaneous members. Submit structural calculations for review prepared by a Professional Structural Engineer licensed in the State of New Jersey which include:

SECTION 054000 - COLD-FORMED METAL FRAMING

- a. Design criteria.
  - b. Structural analysis for each unique framing application.
  - c. Selection of framing components and accessories and of connections.
  - d. All calculations must be signed and sealed by the Contractor's Professional Structural Engineer.
5. Performance Criteria:
- a. See Loading Schedule on the drawings for gravity loads, wind load, and seismic load design criteria.
6. Lateral Load deflection of walls shall be limited to:
- a. L/720 for exterior walls bracing masonry.
  - b. L/360 for other walls.
7. Certifications - submit statements from the framing manufacturer certifying conformance with applicable standards outlined in Part 2.2.
8. Literature - submit technical literature prepared by the framing manufacturer.

1.3 QUALITY ASSURANCE

- A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."
- B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel".
- C. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction. D. American Society of Testing Materials (ASTM) Specifications:
  1. A-446 Standard Specification for Sheet Steel, Zinc Coated by the Hot Dip Process, Structural (Physical) Quality.
  2. C-955 Standard Specification for Load Bearing (Transverse and Axial) Steel Studs, Runner (Track) and Bracing and Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.
  3. C-1007 Standard Specification for the Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- E. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical

SECTION 054000 - COLD-FORMED METAL FRAMING

work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

1. Coordinate with provisions of Division 1 Section "Project Meetings".
- F. Product Delivery and Storage: 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. Materials shall be stored flat and in a manner to prevent distortion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Dale Industries, Inc.
  2. Dietrich Industries, Inc.
  3. Marino/Ware, Inc.

2.2 METAL FRAMING

- A. System Components: Manufacturers' standard load-bearing steel studs and joists of type, size, shape and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system. Studs, runners (track), bracing and bridging shall be manufactured per ASTM C-955.
- B. Structural Properties: Framing products shall possess minimum structural properties equal to sections manufactured by Marino/Ware including Net Area, I, S, r, etc. C. Materials and Finishes:
1. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi; ASTM A446.
  2. For 18-gage and lighter units fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A446.
  3. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.
  4. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

**SECTION 054000 - COLD-FORMED METAL FRAMING**

5. Electrodes for Welding: Comply with AWS Code as recommended by stud manufacturer.
6. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.
7. Use 18 Gauge (minimum) material.
8. Track gauge and strength shall match studs.
9. Studs and joists shall have a minimum flange width of 1 5/8"

**2.3 FABRICATION**

- A. General: Framing components must be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Provisions for lifting of prefabricated units to prevent damage or distortion shall be included in the frames design and construction. Isolated areas may be stick built in place if prior approval is received from the Architect.
- B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.
- D. Wire tying of framing components is not permitted.
- E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Examine the areas and conditions where lightgauge metal framing is 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. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations and requirements of Contractor's engineer.
  1. Field cutting of steel framing members shall be by saw or shear. Torch cutting will not be permitted except by written approval of the Architect.

SECTION 054000 - COLD-FORMED METAL FRAMING

2. Temporary bracing shall be provided and remain in place until work is permanently stabilized.
  3. Insulation, equal to the requirements specified in Division 7 and per code minimums, shall be placed in components inaccessible to the insulation contractor after their installation.
  4. Where splicing of track is necessary between stud spacings, a piece of stud shall be placed between adjacent tracks and fastened by weld or screw to each side of the track, each end. Tracks shall not be spliced within floor opening adjacent to wall.
  5. Splicing of framing components, other than track, is not permitted.
  6. Studs shall be spaced as shown in the reviewed shop drawings or as required to meet the design requirements and limitations of the collateral materials.
  7. A non-shrink grout leveling layer shall be applied to concrete or masonry surfaces prior to anchoring tracks.
  8. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
  9. 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.
- B. Installation: Non-Load Bearing Walls (Curtainwall).
1. Studs shall be plumbed, aligned and secured to the continuous runner tracks at each end and each side. Unless the stud end terminates at a deflection track.
  2. Mechanical bridging, of the type and spacing described in reviewed shop drawings shall be installed prior to the installation of facing materials.
  3. Provide multiple studs at jambs of wall openings. Individual studs forming the jamb shall be attached together at intervals described in the reviewed shop drawings.
- C. Installation: Load Bearing Walls (Axial).
1. Studs shall be installed seated squarely (within 1/16") against the web of the top and bottom track to assure transfer of axial load. Studs shall be plumbed, aligned and secured to the continuous runner tracks at each end and each side before the installation of components which induce axial load.
  2. Track shall rest on a continuous bearing surface. If not provided, install full size shims below track at stud locations or set bottom track in high strength grout. Bridging of the type and spacing described in the reviewed shop drawings shall be installed before loading.

SECTION 054000 - COLD-FORMED METAL FRAMING

3. Framed wall openings shall include headers and supporting components as shown in the reviewed shop drawings.
4. Installation of shear wall ("X" braced) assemblies as shown in the reviewed shop drawings shall be completed before the attachment of facing materials and/or the erection of ascending levels.
5. Floor and roof components shall directly align over a stud. Where the floor or roof components do not directly align over a stud, a continuous distribution member shall be provided at the top of the wall. Do not use the top track as a distribution header.
6. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system. D. Installation: Horizontal Joists or Rafters.
  1. Provide web stiffeners at support locations where indicated in the reviewed shop drawings.
  2. Mechanical Bridging, of the type and spacing described in the reviewed shop drawings shall be installed before loading.
  3. Provide an additional joist under parallel, non-load bearing partitions when the partition length exceeds one-half the joist span or where shown on the contract drawings.
  4. End blocking shall be provided where joist ends are not restrained against rotation.
  5. Provide additional framing around openings, as shown in the contract documents or reviewed shop drawings when the width of the opening exceeds the typical joist/rafter spacing.
  6. During construction, the floor/rafter system shall not be loaded beyond the limits for which it was designed. E. Connections:
    1. Welds:
      - a. Welds shall be of the type, size and location shown in the reviewed shop drawings.
      - b. Welded connections shall be performed in accordance with the American Welding Society (AWS) Specification for Welding Sheet Steel in Structures, D1.3.
      - c. Welders, welding operations and welding procedures shall be qualified in accordance with AWS D1.3.
      - d. Consult applicable AWS specifications for information regarding safe welding procedures.
      - e. Welds shall be cleaned and coated with rust inhibitive galvanizing paint.
    2. Screws:



SECTION 054000 - COLD-FORMED METAL FRAMING

- a. Screws shall be of the type, size and location shown in the reviewed shop drawings.
  - b. Screw penetration through jointed materials shall not be less than three exposed screw threads.
  - c. Contractor shall refer to installation instructions published by the screw manufacturer and ASTM C-954 for minimum spacing and edge distance requirements and torque requirements.
3. Concrete anchors:
- a. Types: Anchor bolts, epoxy bolts, wedge expansion bolts, screw type concrete fasteners, powder actuated fasteners shall be as manufactured by Hilti Corp. Size, type and location shall be as shown in the reviewed shop drawings.
  - b. Concrete anchors shall not be installed until full compressive strength is obtained.
  - c. Contractor shall refer to instructions published by the anchor manufacturer for minimum spacing, edge distance and concrete embedment and additional installation requirements.

END OF SECTION 054000

**SECTION 06 1643 GYPSUM SHEATHING**

**PART 1- GENERAL**

**1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Gypsum Wall Sheathing.
  - 2. Sheathing Joint and Penetration Treatment.
  
- B. Related Sections include the following:
  - 1. Section 06 1053 – Rough Carpentry.

**1.02 REFERENCES**

- A. American Society for Testing and Materials:
  - 1. ASTM C 79: Standard Specification for Treated Core and Nontreated Core Gypsum Sheathing Board.
  - 2. ASTM C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.110 inch in Thickness.
  - 3. ASTM C 1002: 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 C 1280: Standard Specification for Application of Gypsum Sheathing.
  - 5. ASTM C 1396: Standard Specification for Gypsum Board.
  - 6. ASTM D 226: Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
  - 7. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 8. ASTM E 119: Test Method for Fire Tests of Building Construction and Materials.
  - 9. ASTM E 1677: Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls.
  
- B. Gypsum Association:
  - 1. GA 253: Recommended Specification for the Application of Gypsum Sheathing.

**1.03 SUBMITTALS**

- A. General: See General Conditions Article 4.7 for submittal procedures
  
- B. Product Data: Submit manufacturer's current technical literature for product specified.

**1.04 QUALITY ASSURANCE**

- A. Fire Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested in accordance to ASTM E 119 by an independent testing and inspection agency acceptable to authorities having jurisdiction.
  - 1. Fire Resistance Ratings: Indicated by design designations from UL "Fire Resistance Directory.

**SECTION 06 1643 GYPSUM SHEATHING**

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. **WARNING:** Store all Gypsum Sheathing flat. Panels are heavy and can fall over, causing serious injury or death. Do not move unless authorized.

**PART 2- PRODUCTS**

**2.01 WALL SHEATHING**

- A. Paper-Surfaced Gypsum Sheathing: ASTM C 79 or ASTM C 1396, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
  - 1. Basis of Design - Product: Subject to compliance with requirements, provide SHEETROCK Brand Gypsum Sheathing by United States Gypsum Company.
  - 2. Type and Thickness: Regular, 5/8 inch thick.
  - 3. Edge and End Configuration: Square.
  - 4. Size: 48 by 96 inches for vertical installation.  
Acceptable manufacturers' products complying with all specified requirements include:
    - a. National Gypsum Company
    - b. USG Corp.
    - c. Georgia Pacific
    - d. Approved Equal

**2.02 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
- B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel or Sheathing SF steel drill screws 1-1/4 inch min. with corrosion-resistant coating.
  - 1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
  - 2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

**2.03 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS**

- A. Sealant for Paper-Surfaced Gypsum Sheathing Board: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Section 07920 – Joint Sealants.

**PART 3- EXECUTION**

**3.01 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.

**SECTION 06 1643 GYPSUM SHEATHING**

- C. Coordinate wall sheathing installation with flashing and joint-sealant installation so 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.

**3.02 GYPSUM SHEATHING INSTALLATION**

- A. Comply with ASTM C 1280, GA-253 and manufacturer's written instructions.
  - 1. Fasten sheathing to cold-formed metal framing with screws.
  - 2. Install boards with a **3/8-inch** gap where non-load-bearing construction abuts structural elements.
  - 3. Install boards with a **1/4-inch** gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  - 1. Space fasteners approximately **8 inches** o.c. and set back a minimum of **3/8 inch** from edges and ends of boards.
  - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

**3.03 SHEATHING JOINT-AND-PENETRATION TREATMENT**

- A. Apply elastomeric sealant to joints and fasteners. Seal all penetrations and openings.

**3.04 PROTECTION**

- A. Paper-Surfaced Gypsum Sheathing: When applied to a structure, sheathing must not be left exposed to the elements for more than one month unless all gaps resulting from cuts, corners, joints and machine-end cuts of the sheathing are filled with an elastomeric sealant at the time of erection to protect the sheathing from water intrusion. This treatment will extend exposure time to six months. Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing barrier securely fastened to framing. Apply covering immediately after sheathing is installed.

END OF SECTION

**SECTION 062000- FINISH CARPENTRY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Finish carpentry items.
- B. Wood casings and moldings.

**1.2 RELATED SECTIONS**

- A. 061000 – Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. 099000 – Paints and Coatings: Painting and finishing of finish carpentry items.

**1.3 REFERENCES**

- A. Architectural Woodwork Institute / Architectural Woodwork Manufacturers Association of Canada / Woodwork Institute (AWI/AWMAC/WI) - Architectural Woodwork Standards; Edition 1.
- B. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004.
- C. PS 1 - Structural Plywood; 2007.
- D. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.
- E. WI (MAN) - Manual of Millwork; Woodwork Institute; 2003.

**1.4 SUBMITTALS**

- A. See Section 4.7 of General Conditions for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, to a minimum scale of 1-1/2 inch to 1 ft.
- C. Samples: Submit two samples of wood trim 6 inch long.

**1.5 QUALITY ASSURANCE**

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect work from moisture damage.
- B. Protect materials against dampness during and after delivery.
- C. Store materials in ventilated areas, protected from extreme changes of temperature or humidity

**PART 2 - PRODUCTS**

**2.1 MATERIALS - GENERAL**

- A. Unless otherwise indicated provide products of quality specified by AWI Architectural Woodwork Quality Standards Illustrated for Economy grade.
- B. Unless otherwise indicated provide products of quality specified by Woodwork Institute Manual of Millwork for Economy grade.

**2.2 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

**SECTION 062000- FINISH CARPENTRY**

**2.3 LUMBER MATERIALS**

- A. Softwood Lumber: Southern Pine species, maximum moisture content of 9 percent; of quality suitable for transparent finish.
- B. Hardwood Lumber: Poplar species, maximum moisture content of 9 percent of quality suitable for opaque finish.

**2.4 SHEET MATERIALS**

- A. Softwood Plywood: UL Veneer core; Any face species, rotary cut.
- B. Hardwood Plywood: PS 1 Grade A-B; Veneer core; Walnut face species, rotary cut.
- C. All plywood shall be fabricated with adhesives free from added urea-formaldehyde.

**2.5 ADHESIVE**

- A. Adhesive: Type recommended by AWI to suit application.

**2.6 FASTENERS**

- A. Fasteners: Of size and type to suit application; Galvanized finish in concealed locations and Galvanized finish in exposed locations.

**2.7 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify adequacy of backing and support framing.

**3.2 INSTALLATION**

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- C. Form joints to conceal shrinkage

**3.3 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Sand work smooth.
- B. Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely
- C. Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer
- D. Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured
- E. Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises
- F. Butt and cope internal joints of baseboards to make snug, tight, joint. Cut right angle joints of casing and base with mitred joints

**SECTION 062000- FINISH CARPENTRY**

- G. Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls
- H. Make joints in baseboard, where necessary using a 45° scarf type joint
- I. Install door and window trim in single lengths without splicing
- J. Site Finishing: See Section 099000.

**3.4 ERECTION TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

**END OF SECTION**

**SECTION 064100 - ARCHITECTURAL WOOD CASEWORK**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Special fabricated cabinet units.
  - 2. Plastic laminate countertops.
  - 3. Shop finishing.
  - 4. Cabinet hardware.
  
- B. Related Sections:
  - 1. Division 01: Administrative, procedural, and temporary work requirements.
  - 2. Section 06 6116 - Solid Surfacing Fabrications.
  - 3. Section 07 9200 - Joint Sealers.
  - 4. Section 12 3640 - Stone Countertops.

1.2 REFERENCES

- A. Architectural Woodwork Institute (AWI) - Architectural Woodwork Quality Standards.
  
- B. Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA) LD-3 - High Pressure Decorative Laminates.
  
- C. Forest Stewardship Council (FSC) STD-40-004 - Chain of Custody Standard.

1.3 SUBMITTALS

- A. Submittals for Review:
  - 1. Shop Drawings:
    - a. Include dimensioned plan, sections, elevations, and details, including interface with adjacent work.
    - b. Designate wood species and finishes.
  - 2. Samples:
    - a. [3 x 3] inch plastic laminate samples [showing available colors and finishes.] [in each color and finish selected for the project.]
    - b. Each hardware component.
    - c. [12 x 12] inch panel product samples.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications:
  - 1. Minimum [5] years [documented] experience in work of this Section.
  - 2. Certified under AWI Quality Certification Program.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials until proper protection can be provided, and until needed for installation.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: HVAC system complete and operational for minimum [7] days prior to installation of cabinets.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

064100-1



**SECTION 064100 - ARCHITECTURAL WOOD CASEWORK**

A. Acceptable Manufacturers - Plastic Laminate:

1. Arborite ([www.arborite.com](http://www.arborite.com))
2. Formica Corp. ([www.formica.com](http://www.formica.com))
3. Nevamar Co. ([www.nevamar.com](http://www.nevamar.com))
4. Wilsonart International, Inc. ([www.wilsonart.com](http://www.wilsonart.com))

B. Substitutions: [Under provisions of Division 01.] [approved equal.]

2.2 MATERIALS

A. Hardboard: Pressed wood fiber with resin binder; standard grade, ¼ inch thick, smooth [both sides.]

B. Plastic Laminate: NEMA LD-3.

1. Horizontal surfaces:
  - a. Backing sheet: Grade [BGF.]
  - b. Postformed surfaces: Grade [HGP.]
  - c. Acid resisting: Grade [LGP.]
  - d. Other surfaces: Grade [HGS.]
2. Vertical surfaces:
  - a. Backing sheet: Grade [BLF.]
  - b. Cabinet liner: Grade [CLS.]
  - c. Other surfaces: Grade [VGP.]
3. Melamine laminate: Grade VGL.
4. Colors: Refer to drawings
5. Finish: Refer to drawings

C. Lumber:

1. Graded in accordance with AWI Section 100 requirements for quality grade specified, average moisture content of [6] percent.
2. Exposed and semi-exposed locations: maple species, of quality suitable for [transparent] finish.
3. Closed grain hardwood of quality suitable for opaque finish.

2.3 ACCESSORIES

A. Fasteners: Type and size as required by conditions of use.

B. Adhesives:

1. Waterproof, type, compatible with backing and laminate materials.

C. Hardware:

- Hinges: Clip top Blumotion with tip-on. Min. of (2) per door
- Adjustable shelf pins: Richelieu angle metal shelf clip, finish: nickel

D. Joint Sealers: Specified in Section 07 9200.

2.4 FABRICATION

A. Cabinets - Plastic Laminate Finish:

1. Quality: AWI Section 400, [Premium] [Custom] [Economy] Grade.
2. Type: [Flush overlay.] [Reveal overlay with 5/8 inch horizontal at top of cabinet door and vertical reveals. 3/16.
3. Semi-exposed surfaces: [Plastic laminate.]
4. Fit exposed and semi-exposed panel edges with matching [laminate] edging.
5. Fabricate shelving to full depth of cabinet less [1/2] inch.

**SECTION 064100 - ARCHITECTURAL WOOD CASEWORK**

- B. Plastic Laminate Countertops:
  - 1. Quality: AWI Section 400, [Premium] Grade.
  - 2. Fabricate from panel product with lumber fronts.
  - 3. Locate end joints centered or symmetrical. Join sections with concealed clamp fasteners. Locate plastic laminate butt joints minimum [2] feet away from sinks.
  - 4. Provide holes and cutouts for mounting of sinks, trim, water lines and accessories. For holes provide white grommets.
  - 5. Scribe counter back to wall and fill joint with color matching sealant.
- C. Shop assemble for delivery to project site in units easily handled.
- D. Prior to fabrication, field verify dimensions to ensure correct fit.
- E. Apply plastic laminate in full uninterrupted sheets; fit corners and joints to hairline. Slightly bevel arises. Apply laminate backing sheet to reverse side of laminate faced surfaces.
- F. Where field fitting is required, provide ample allowance for cutting. Provide trim for scribing and site conditions.
- G. Provide cutouts and reinforcement for [plumbing,] [electrical,] [appliances,] [and] [accessories]. Prime paint surfaces of cut edges.
- H. Provide 4" laminate kicks scribed to floor.

2.5 FINISHES

**PART 3 EXECUTION**

3.1 PREPARATION

- A. Prior to installation, condition cabinets to average humidity that will prevail after installation.

3.2 INSTALLATION

- A. Install in accordance with AWI Section 1700, [Premium] Grade requirements.
- B. Set plumb, rigid and level.
- C. Scribe to adjacent construction with maximum [1/8] inch gaps.
- D. Adhere countertops, splashes, and skirts with beads of adhesive.
- E. Fill joints between tops and splashes with sealant as specified in Section 07 9200; finish flush.

**END OF SECTION**

**SECTION 072116 BLANKET INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Thermal batt and blanket insulation.
- B. Drawings, the provisions of the Agreement, the General Conditions, and Division 1 specification sections apply to all work of this Section.

**1.2 RELATED SECTIONS:**

- A. 072113 – Board Insulation.
- B. 098100 – Acoustic Insulation.

**1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. C612 - Mineral Fiber Block and Board Thermal Insulation
  - 2. C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - 3. E84 - Test Method for Surface Burning Characteristics of Building Materials.

**1.4 SUBMITTALS**

- A. Make submittals under provisions of Article 4.7 of General Conditions.
- B. Product Data: Submit manufacturer's product data and installation instructions for each type of insulation.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Unfaced Acoustical Batt and Blanket Insulation:
  - 1. Manufacturer:
    - a. Basis of Design: Rockwool AFB [www.Rockwool.com](http://www.Rockwool.com)
      - 1) CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
      - 2) Knauf Insulation (800-825-4434).
      - 3) Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
      - 4) Approved equal
  - 2. Type: "Unfaced Formaldehyde-Free Thermal semi-rigid bat stone wool Insulation" Rockwool AFB; ASTM C665,
  - 3. Flame spread 0 or less and smoke developed of 0 or less when tested in accordance with ASTM E84.
  - 4. Thermal Resistance (R-value): As indicated on the Drawings.
  - 5. Furnish oversize widths for friction-fit between metal framing members.

**2.2 ACCESSORIES**

- A. Provide other accessories, not specifically described, but required for secure and tight installation of insulation with complete insulation fill within cavities, and continuous vapor retarder.

**SECTION 072116 BLANKET INSULATION**

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify adjacent materials are secure, properly spaced, dry, and ready to receive installation.
- B. Verify mechanical and electrical services within spaces to insulated have been installed and tested.
- C. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- D. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

**3.2 BATT AND BLANKET INSULATION**

- A. Install batt insulation in accordance with manufacturer's instructions.
- B. Install insulation without gaps or voids.
- C. Trim insulation neatly to fit spaces. Use batts free of damage.
- D. At metal stud framing, insert the insulation edges tightly into the stud channels for a friction fit. Provide additional supports as necessary to prevent sliding of batts in the stud cavity.
- E. Mechanical Fastening:
  - 1. At locations where no framing is present to support the insulation, provide impaling pins and retainers to hold the insulation firmly in position.
  - 2. Mechanically or adhesively bond the impaling pins to the substrate in accordance with the manufacturer's recommendations.
  - 3. Space pins at maximum 24 inches on center along the edges and within the field of the blanket. Place edge pins within 6 inches from the edge of the batt.
- F. Pack batt insulation in shim spaces at perimeter of window assembly to maintain continuity of thermal barrier.

**END OF SECTION**

**SECTION 072616 - UNDER-SLAB VAPOR BARRIER/RETARDER**

**PART 1 – GENERAL**

1.1 SUMMARY

- A. Products Supplied Under This Section
  - 1. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- B. RELATED SECTIONS
  - 1. Section 03300 Cast-in-place Structural Concrete

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
  - 2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
  - 3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
  - 4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
  - 1. ACI 302.2R-06 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick

1.3 SUBMITTALS

- A. Quality Control / Assurance
  - 1. Manufacturer's samples, literature
  - 2. Manufacturer's installation instructions for placement, seaming and pipe boot installation

1.4 SUBSTITUTIONS

- A. Product Review
  - 1. Independent laboratory test results showing compliance with ASTM E 1745 (Class A) & ACI 302.2R-06 (less than 0.01 perms) standards. (Woven plastics are not permitted)
  - 2. Request must be made 14 days prior to bid date to allow time for proper review.

**PART 2 – PRODUCTS**

2.1 MATERIALS

- A. Vapor Barrier: When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision.
  - 1. Vapor Barrier membrane must have the following properties.
    - a. Permeance rating Per ASTM E 96 or ASTM F 1249  
Must meet permeance requirements for both the new material and following ASTM E-1745 mandatory conditioning tests (ASTM E 154; Sections 8, 11, 12, 13):
      - i. New material                      Less than 0.01 perms (gr/ft<sup>2</sup>/hr/in-Hg)
      - ii. After conditioning                Less than 0.01 perms (gr/ft<sup>2</sup>/hr/in-Hg)
    - b. Water Vapor Barrier                ASTM E 1745 Meets or exceeds Class A
    - c. Minimum thickness                ACI 302.1R-06 10 mils
    - d. Manufactured from prime virgin resins
    - e. Basis of Design: Stego Wrap 15- mil Vapor Barrier by Stego Industries LLC
    - f. Other Acceptable Vapor Barrier Products:
      - i. VaporGuard by Reef Industries, Inc
      - ii. Zero-Perm, by Alumiseal
      - iii. Approved Equal

**SECTION 072616 - UNDER-SLAB VAPOR BARRIER/RETARDER**

2.2 ACCESSORIES

A. Seam Tape

1. Tape must have the following qualities:
  - a. Water Vapor Transmission Rate                      ASTM E 96            0.3 perms or lower

B. Vapor Proofing Mastic

1. Mastic must have the following qualities:
  - a. Water Vapor Transmission Rate                      ASTM E 96            0.3 perms or lower

C. Pipe Boots

1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

**PART 3 – EXECUTION**

3.1 PREPARATION

A. Ensure that subsoil is approved by architect or geotechnical firm

1. Level and tamp or roll aggregate, sand or tamped earth base.

3.2 INSTALLATION

A. Install Vapor Barrier/Retarder:

1. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98 (2005).
  - a. Unroll Vapor Barrier/Retarder with the longest dimension parallel with the direction of the pour.
  - b. Lap Vapor Barrier/Retarder over footings or seal to foundation walls.
  - c. Overlap joints 6 inches and seal with manufacturer's tape.
  - d. Seal all penetrations (including pipes) per manufacturer's instructions.
  - e. No penetration of the Vapor Barrier/Retarder is allowed except for reinforcing steel and permanent utilities.
  - f. Repair damaged areas by cutting patches of Vapor Barrier/Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

**END OF SECTION**

**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

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. Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing system on metal deck, including but not limited to:
  - a. Roof insulation.
  - b. Roof membrane and membrane base flashings.
  - c. Roof surfacing consisting of surfacer with top coating.

B. Related Sections:

- 1. Division 01 Section "Sustainable Design Requirements" for additional sustainable design requirements.
- 2. Division 06 carpentry section for wood nailers, wood cants, curbs, and blocking.
- 3. Division 07 Section "Preparation for Re-Roofing" for recover board beneath new membrane roofing.
- 4. Division 07 Section "Thermal and Moisture Protection Rehabilitation" for rehabilitation of related non-roof building components.
- 5. Division 07 Section "Sheet Metal Flashing and Trim" for custom metal roof penetration flashings, flashings, and counterflashings.
- 6. Division 07 Section "Roof Specialties" for manufactured copings, roof edge flashings, roof edge drainage systems, counterflashings, and reglets.
- 7. Division 07 Section "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
- 8. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
- 9. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Provide roof plan showing orientation and types of roof deck, orientation of membrane roofing, and fastening spacings and patterns for mechanically fastened components.
  - 1. Base flashings and built-up terminations.
    - a. Indicate details meet requirements of NRCA and FMG required by this Section.
  - 2. Tapered insulation, including slopes.
  - 3. Crickets, saddles, and tapered edge strips, including slopes.
  - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.
- B. Qualification Data: For Installer, Manufacturer, and Roofing Inspector.
  - 1. Include letter from Manufacturer written for this Project indicating approval of Installer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of built-up roofing.
- D. Warranties: Unexecuted sample copies of special warranties.
- E. Field Quality Control Reports: Daily reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.
- B. Warranties: Executed copies of warranties.



**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.
- B. Manufacturer Qualifications: Approved manufacturer with UL listed roofing systems comparable to those specified for this Project, with minimum five years' experience in manufacture of comparable products in successful use in similar applications, and able to furnish warranty with provisions matching specified requirements.
  - 1. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.
  - 2. Approved manufacturers must meet separate requirements of Submittals Article.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
  - 1. An authorized full-time technical employee of the manufacturer.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products.
- E. Preinstallation Roofing Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review drawings and specifications.
  - 3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 5. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 6. Review structural loading limitations of roof deck during and after roofing.
  - 7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

8. Review governing regulations and requirements for insurance and certificates if applicable.
9. Review temporary protection requirements for roofing system during and after installation.
10. Review roof observation and repair procedures after roofing installation.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

**1.9 PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.
  2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
  3. Remove temporary plugs from roof drains at end of each day.
  4. Remove and discard temporary seals before beginning work on adjoining roofing.

**1.10 WARRANTY**

- A. Warranty, General: Warranties specified shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

- B. **Manufacturer's Warranty:** Manufacturer's standard or customized form in which manufacturer agrees to repair or replace components of built-up roofing that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  - 1. Manufacturer's warranty includes roofing membrane, base flashings, fasteners, roofing membrane accessories and other components of roofing system specified in this Section.
  - 2. Warranty Period: 20 years from date of Substantial Completion.
- C. **Installer's Warranty:** Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section and related Sections indicated above, including all components of built-up roofing such as built-up roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  - 1. Warranty Period: Five years from date of Substantial Completion.
- D. **Extended Roof System Warranty:** Warranties specified in this Section include the following components and systems specified in other sections supplied by the roofing system Manufacturer, and installed by the roofing system Installer:
  - 1. Sheet metal flashing and trim, including roof penetration flashings.
  - 2. Manufactured copings, roof edge, counterflashings, and reglets.
  - 3. Roof curbs, hatches, and penetration flashings.
  - 4. Roof and parapet expansion joint assemblies.
  - 5. Metal roof, wall, and soffit panels and trim.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. **Manufacturers:** Subject to compliance with requirements, provide products by a manufacturer listed below.
  - 1. Tremco Incorporated.
  - 2. Ecology Commercial and Industrial Roofing Systems.
  - 3. Garland Company, Inc. (The).

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2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Roofing shall withstand exposure to weather without failure or leaks due to defective manufacture or installation.
  - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

2.3 ROOFING MEMBRANE MATERIALS

- A. Roofing Ply Sheets (2):
  - 1. ASTM D 4601 Type II non-perforated SBS-modified asphalt coated fiberglass/fiberglass/polyester reinforced high tensile strength sheet dusted with fine mineral surfacing on both sides.
    - a. Basis of design product: Tremco, BURmastic Composite Ply HT.
    - b. Tensile Strength, minimum, ASTM D 5147: Machine direction, 165 lbf/in (28.9 kN/m); Cross machine direction, 150 lbf/in (26.3 kN/m).
    - c. Tear Strength, minimum, ASTM D 5147: Machine direction, 210 lbf (0.9 kN); Cross machine direction, 185 lbf (0.8 kN).
    - d. Elongation at 77 deg. F (25 deg. C), minimum, ASTM D 5147: 6 percent.
    - e. Thickness, minimum, ASTM D 146: 0.055 inch (1.4 mm).
- B. SBS Modified Bituminous Cap Sheet:
  - 1. ASTM D 6162 Type III Grade G SBS/SEBS-modified asphalt-coated composite polyester and glass-fiber-reinforced sheet, granular surfaced.
    - a. Basis of design product: Tremco, POWERply 300 FR.
    - b. Exterior Fire-Test Exposure, ASTM E 108: Class A.
    - c. Tensile Strength at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction 345 lbf/in (60. kN/m); Cross machine direction 340 lbf/in (60 kN/m).
    - d. Tear Strength at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction, 600 lbf (2.6 kN); Cross machine direction 580 lbf (2.5 kN).

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- e. Elongation at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction 12.0 percent; Cross machine direction 8.0 percent.
  - f. Low Temperature Flex, maximum, ASTM D 5147: -35 deg. F (-37 deg. C).
  - g. Thickness, minimum, ASTM D 5147: 0.138 inch (3.5 mm).
- C. Base Flashing Backer Sheet:
- 1. ASTM D 4601 Type II non-perforated SBS-modified asphalt coated fiberglass/fiberglass/polyester reinforced high tensile strength sheet dusted with fine mineral surfacing on both sides.
    - a. Basis of design product: Tremco, BURmastic Composite Ply HT.
    - b. Tensile Strength, minimum, ASTM D 5147: Machine direction, 165 lbf/in (28.9 kN/m); Cross machine direction, 150 lbf/in (26.3 kN/m).
    - c. Tear Strength, minimum, ASTM D 5147: Machine direction, 210 lbf (0.9 kN); Cross machine direction, 185 lbf (0.8 kN).
    - d. Elongation at 77 deg. F (25 deg. C), minimum, ASTM D 5147: 6 percent.
    - e. Thickness, minimum, ASTM D 146: 0.055 inch (1.4 mm).
- D. Base Flashing Material:
- 1. ASTM D 6162 Type III Grade G SBS/SEBS-modified asphalt-coated composite polyester and glass-fiber-reinforced sheet, granular surfaced.
    - a. Basis of design product: Tremco, POWERply 300 FR.
    - b. Exterior Fire-Test Exposure, ASTM E 108: Class A.
    - c. Tensile Strength at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction 345 lbf/in (60. kN/m); Cross machine direction 340 lbf/in (60 kN/m).
    - d. Tear Strength at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction, 600 lbf (2.6 kN); Cross machine direction 580 lbf (2.5 kN).
    - e. Elongation at 73 deg. F (23 deg. C), minimum, ASTM D 5147: Machine direction 12.0 percent; Cross machine direction 8.0 percent.
    - f. Low Temperature Flex, maximum, ASTM D 5147: -35 deg. F (-37 deg. C).
    - g. Thickness, minimum, ASTM D 5147: 0.138 inch (3.5 mm).
- E. Detail Fabric:

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1. Woven Glass Fiber Mesh, Vinyl-Coated: Non-shrinking, non-rotting, vinyl-coated woven glass mesh for reinforcing flashing seams, membrane laps, and other roof system detailing..
  - a. Basis of design product: Tremco, BURmesh.
  - b. Tensile strength, 70 deg. F, ASTM D 146: Warp, 65 lbf/in (289 N); fill, 75 lbf/in (311 N).

2.4 COLD-APPLIED ADHESIVE MATERIALS

- A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
  1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
  2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Ply Sheet Adhesive:
  1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BIO Preferred, formulated for compatibility and use with specified roofing membranes and flashings.
    - a. Basis of design product: Tremco, POWERply Endure BIO Adhesive (PEBA).
    - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3690: 1 g/L.
    - c. Low Temperature Flexibility, ASTM D 2240: 88 Shore A.
    - d. Solids, by Volume, ASTM D 2697: 100 percent.
    - e. Bio base Content, ASTM D 6866: Not less than 70 percent.
- C. Cap Sheet Adhesive:
  1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BIO Preferred, formulated for compatibility and use with specified roofing membranes and flashings.
    - a. Basis of design product: Tremco, POWERply Endure BIO Adhesive (PEBA).
    - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3690: 1 g/L.
    - c. Low Temperature Flexibility, ASTM D 2240: 88 Shore A.

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- d. Solids, by Volume, ASTM D 2697: 100 percent.
  - e. Bio base Content, ASTM D 6866: Not less than 70 percent.
- D. Flashing Backer Sheet Adhesive:
- 1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BIO Preferred, formulated for compatibility and use with specified roofing membranes and flashings.
    - a. Basis of design product: Tremco, POWERply Endure BIO Adhesive (PEBA).
    - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3690: 1 g/L.
    - c. Low Temperature Flexibility, ASTM D 2240: 88 Shore A.
    - d. Solids, by Volume, ASTM D 2697: 100 percent.
    - e. Bio base Content, ASTM D 6866: Not less than 70 percent.
- E. Flashing Sheet Adhesive:
- 1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BIO Preferred, formulated for compatibility and use with specified roofing membranes and flashings.
    - a. Basis of design product: Tremco, POWERply Endure BIO Adhesive (PEBA).
    - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3690: 1 g/L.
    - c. Low Temperature Flexibility, ASTM D 2240: 88 Shore A.
    - d. Solids, by Volume, ASTM D 2697: 100 percent.
    - e. Bio base Content, ASTM D 6866: Not less than 70 percent.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- G. Mastic Sealant: Polyisobutylene, plain or modified bitumen, nonhardening, nonmigrating, no skinning, and nondrying.
- 2.5 AUXILIARY ROOFING MATERIALS
- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
  - B. Stripping Reinforcing Fabric:

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1. Woven Glass Fiber Mesh, Vinyl-Coated: Non-shrinking, non-rotting, vinyl-coated woven glass mesh for reinforcing flashing seams, membrane laps, and other roof system detailing.
  - a. Basis of design product: Tremco, BURmesh.
  - b. Tensile strength, 70 deg. F, ASTM D 146: Warp, 65 lbf/in (289 N); fill, 75 lbf/in (311 N).
- C. Joint Sealant: Elastomeric joint sealant compatible with roofing materials, with movement capability appropriate for application.
  1. Joint Sealant, Polyurethane: ASTM C 920, Type S, Grade NS, Class 50 single-component moisture curing sealant, formulated for compatibility and use in dynamic and static joints; paintable.
    - a. Basis of design product: Tremco, TremSEAL Pro.
    - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 40 g/L.
    - c. Hardness, Shore A, ASTM C 661: 40.
    - d. Adhesion to Concrete, ASTM C 794: 35 pli.
    - e. Tensile Strength, ASTM D 412: 350 psi.
    - f. Color: Aluminum.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."
- F. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

**2.6 ROOF INSULATION**

- A. Roof Insulation, General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
  1. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
  2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- B. Roof Insulation:



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1. Polyisocyanurate board insulation, ASTM C 1289 Type II Class 1 CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces.
    - a. Compressive Strength, ASTM C1621: Grade 2: 20 psi (138 kPa)
    - b. Conditioned Thermal Resistance at 75 deg. F (24 deg. C): 14.4 at 2.5 inches (50.8 mm) thick.
  - C. Roof Insulation Cover Board:
    1. Cellulosic fiber reinforced water-resistant gypsum panel, ASTM C 1278/C 1278M.
      - a. Basis of design product: Tremco/USG Securock.
      - b. Thickness: 1/2 inch (13 mm).
  - D. Roof Insulation Adhesive:
    1. Cold fluid-applied bead-applied low-rise adhesive, two-component solvent-free low odor elastomeric urethane, formulated to adhere roof insulation to substrate.
      - a. Basis of design product: Tremco, Low Rise Foam Insulation Adhesive.
      - b. Flame Spread Index, ASTM E 84: 10.
      - c. Smoke Developed Index, ASTM E 84: 30.
      - d. Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 0 g/L.
      - e. Tensile Strength, minimum, ASTM D 412: 250 psi (1724 kPa).
      - f. Peel Adhesion, minimum, ASTM D 903: 17 lbf/in (2.98 kN/m).
      - g. Flexibility, 70 deg. F (39 deg. C), ASTM D 816: Pass.
  - E. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
  - F. Wood Cant Strips: Comply with requirements in Division 06 carpentry section.
  - G. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
  - H. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass-fiber joint tape.
- 2.7 SURFACING MATERIALS
- A. Flashing Seam Lap Roof Cement:
    1. Elastomeric Roofing Mastic, Solvent-Free: One-part, low-odor elastomeric roof mastic specially formulated for compatibility and use with specified roofing membranes and flashings.

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- a. Basis of design product: Tremco, POLYroof SF.
  - b. Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 20 g/L.
  - c. Elongation at 77 deg. F (25 deg. C), minimum, ASTM D 412: 300 percent.
- B. Acrylic Emulsion Coating Material:
- 1. Acrylic Coating: Highly-reflective water-based low-odor and low-VOC semi-gloss coating formulated with fluoropolymer resin for use as a finish coat over water-based acrylic roof and wall coatings and other approved substrates.
    - a. Basis of design product: Tremco, T24 Coating.
    - b. Volatile Organic Content (VOC), ASTM D 3960: < 50 g/L.
    - c. Gloss at 60 deg, ASTM D 523: 60 percent.
    - d. Solar Reflectance, ASTM C 1549: 88 percent initial; 82 percent 3-year aged.
    - e. Thermal Emittance: 0.89 initial; 0.86 3-year aged.
    - f. Solar Reflectance Index (SRI), ASTM E 1980: 111 initial; 102 3-year aged.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Steel Roof Deck:
    - a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
    - b. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**SECTION 075216.13-SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, COLD-APPLIED**

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION, GENERAL

- A. Install roofing system in accordance with manufacturer's recommendations.
- B. Install wood cants, blocking, curbs, and nailers in accordance with requirements of Division 06 carpentry section.
- C. Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FMG 4470 as part of a membrane roofing system as listed in FMG's "Approval Guide" for fire/windstorm classification indicated. Comply with recommendations in FMG Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.
- D. Install roofing system in accordance with the following NRCA Manual Plates and NRCA recommendations; modify as required to comply with requirements of FMG references above:
  - 1. Metal Parapet Cap (Coping) and Base Flashing: Plates MB-1 and MB-1S.
  - 2. Surface-Mounted Counterflashing for Concrete Walls (at Parapet Wall): Plates MB-4 and MB-4S.
  - 3. Base Flashing for Wall-supported Deck: Plates MB-5 and MB-5S.
  - 4. Base Flashing for Non-wall-supported deck (Movement Joint): Plates MB-6 and MB-6S.
  - 5. Base and Surface-mounted Counterflashing: Plates MB-4 and MB-4S.
  - 6. Base Flashing for Vented Base Sheet: Plates MB-5A and MB-5AS.
  - 7. Raised Perimeter Edge with Metal Flashing (Fascia Cap): Plates MB-2 and MB-2S.
  - 8. Embedded Edge Metal Flashing Edge (Gravel-stop): Plates MB-3 and MB-3S.
  - 9. Scupper Through Raised Perimeter Edge: Plates MB-21 and MB-21S.
  - 10. Gutter at Draining Edge: Plates MB-22 and MB-22S.
  - 11. Expansion Joint with Metal Cover: Plates MB-7 and MB-7S and Division 07 Section "Sheet Metal Flashing and Trim."

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12. Expansion Joint with Premanufactured Cover: Plates MB-7A and MB-7AS and Division 07 Section "Roof Expansion Assemblies."
13. Area Divider in Roof System: Plates MB-8 and MB-8S.
14. Equipment Support Curb: Plates MB-9 and MB-9S.
15. Equipment Support Stand: Plates MB-10.
16. Equipment Support Stand and Typical Rain Collar Penetration Detail: Plates MB-11 and MB-11S.
17. Raised Curb Detail at Rooftop HVAC Units, Premanufactured: Plates MB-12 and MB-12S and Division 7 Section "Roof Accessories."
18. Raised Curb Detail at Rooftop HVAC Units (Job site constructed wood curb): Plates MB-13 and MB-13S and Division 06 Section "Miscellaneous Rough Carpentry."
19. Skylight, Scuttle (Roof Hatch), and Smoke Vents: Plates MB-14 and MB-14S and Division 07 Section "Roof Accessories."
20. Penetration, Structural Member through Roof Deck: Plates MB-15 and MB-15S.
21. Penetration, Sheet Metal Enclosure for Piping Through Roof Deck: Plates MB-16 and MB-16S
22. Penetration, Isolated Stack Flashing: Plates MB-17 and MB-17S.
23. Penetration, Isolated Stack Flashing: Plates MB-17A and MB-17AS.
24. Penetration, Plumbing Vent: Plates MB-18 and MB-18S.
25. Penetration, Pocket: Plates MB-19 and MB-19S.
26. Roof Drain: Plates MB-20 and MB-20S.
27. Roof Drain: Plates MB-20A and MB-20AS.
28. Guide for Clearances between Pipes / Walls / Curbs - Table 4
29. Guide for Crickets and Saddles - Table 5
30. Guide for Edge Scuppers with Tapered Saddles - Table 6

**3.4 INSULATION INSTALLATION**

- A. Comply with roofing manufacturer's written instructions for installing roof insulation.
- B. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of built-up roofing with vertical surfaces or angle changes greater than 45 degrees.

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- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- G. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
  - 2. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.
  - 1. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining cover in place.

**3.5 COLD-APPLIED ROOFING MEMBRANE INSTALLATION, GENERAL**

- A. Deck Type: Metal deck.
- B. Number of Composite Reinforced-Ply Sheets: Two.
  - 1. Adhering Method: Cold-adhesive applied.
- C. Granular-Surfaced SBS-Modified Asphalt Cap Sheet:
  - 1. Adhering Method: Cold-adhesive applied.
- D. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- E. Cooperate with testing agencies engaged or required to perform services for installing roofing system.

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- F. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work configured as recommended by NRCA Roofing Manual Appendix: Quality Control Guidelines - Insulation to protect new roofing.
  - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
  - 3. Remove temporary plugs from roof drains at end of each day.
  - 4. Remove and discard temporary seals before beginning work on adjoining roofing.
- G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

**3.6 PLY SHEET INSTALLATION**

- A. Install lapped ply-sheets by extending sheet over and terminating beyond cants. Attach ply sheets as follows:
  - 1. Adhere to substrate in uniform coating of cold-applied adhesive.

**3.7 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION**

- A. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
  - 1. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.
  - 2. Embed each ply sheet in cold-applied membrane adhesive applied at rate required by roofing manufacturer.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Install roofing membrane sheets so side and end laps shed water. Completely bond and seal laps, leaving no voids.
  - 1. Repair tears and voids in laps and lapped seams not completely sealed.
  - 2. Apply roofing granules to cover exuded bead at laps.

**3.8 FLASHING AND STRIPPING INSTALLATION**

- A. Base Flashing Installation, General: Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:

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1. Extend base flashing up walls or parapets a minimum of 12 inches (300 mm) above built-up roofing and 6 inches (150 mm) onto field of built-up roofing.
  - B. Backer Sheet Installation: Apply backer sheet to substrate as follows:
    1. Adhere backer sheet to substrate in cold-applied flashing sheet adhesive.
  - C. Flashing Sheet Installation: Adhere flashing sheet to substrate in cold-applied adhesive. Apply cold-applied flashing sheet adhesive to back of flashing sheet if recommended by roofing manufacturer.
    1. Flashing Sheet Top Termination: Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
      - a. Seal top termination of base flashing with a metal termination bar.
    2. Flashing Sheet Bottom Termination: Adhere flashing sheet to roofing membrane in continuous bed of cold-applied adhesive.
      - a. Bituminous Flashing: Seal bottom termination of base flashing by adhering to roofing membrane and sealing flashing edge with joint sealant.
  - D. Metal Flashing Stripping: Install roofing membrane cap sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
  - E. Roof Drains: Set 30 by 30 inch (760 by 760 mm) square metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap sheet stripping and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
    1. Install stripping according to roofing system manufacturer's written instructions.
- 3.9 SURFACING AND COATING INSTALLATION
- A. Acrylic Emulsion Coating over Cold-Applied Surfacing: Coat roofing membrane surface with cold-applied adhesive surfacing adhesive applied at rate required by roofing manufacturer.
    1. Acrylic Emulsion Coating: Apply coating to roofing membrane and base flashings in not less than two coats, with number of coats, thickness of application, and application method as recommended in writing by coating manufacturer.
- 3.10 FIELD QUALITY CONTROL
- A. Roofing Inspector: Owner will engage a qualified roofing inspector to perform roof tests and inspections and to prepare test reports.
  - B. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of 2 full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final

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reports. Roofing Inspector's quality assurance inspections shall comply with criteria established in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."

- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation at commencement and upon completion.
  - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- D. Repair or remove and replace components of built-up roofing where test results or inspections indicate that they do not comply with specified requirements.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216.13



**SECTION 076200 - FLASHING AND SHEET METAL TRIM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fabricated sheet metal items, including copings, drip edges and fascias.

**1.2 REFERENCES**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2006a.
- B. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2006.
- C. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2000 (Reapproved 2006).
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

**1.3 SUBMITTALS**

- A. See General Conditions Article 4.7 for submittal procedures.
- B. Product Data: Catalog cuts and installation instructions for manufactured products.
- C. Shop Drawings: Indicate materials, gages, profiles, jointing patterns, jointing details, fastening methods, and installation details. Include schedule of each type and profile of flashing to be furnished for installation.
- D. Samples: Submit three samples representative of finish and color of prefinished flashing materials.

**1.4 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

**PART 2 - PRODUCTS**

**2.1 SHEET MATERIALS**

Prefinished metal shall be Aluminum-Zinc Alloy Coated (AZ-55 Galvalume®) Steel Sheet, 24-Gauge or 22-Gauge, ASTM 792-08, Grade 40, yield strength 40 ksi min.

Finish shall be full strength Kynar 500® or Hylar 5000™ fluoropolymer coating applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of  $0.75 \pm 0.05$  mil over  $0.20 \pm 0.05$  mil prime coat, to provide a total top side dry film thickness of  $0.95 \pm 0.10$  mil. Bottom side shall be coated with a primer and beige urethane coating with a total dry film thickness of  $0.35 \pm 0.05$  mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500® or Hylar 5000™ finish supplier.

Color shall match adjacent surfaces and approved by architect.

**SECTION 076200 - FLASHING AND SHEET METAL TRIM**

Strippable film shall be applied to the top side of all prefinished metal to protect the finish during fabrication, shipping and field handling. This strippable film MUST be removed immediately before installation.

Field protection must be provided by the contractor at the job site so stacked or coiled material is not exposed to weather and moisture.

Flashing maybe factory fabricated or field fabricated. Unless otherwise specified all exposed adjacent flashing shall be of the same material and finish as panel system.

**2.2 ACCESSORIES**

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment: scheduled weather barrier, See Section 07 2500
- C. Primer: test surface if req. and follow manuf. recommendations.

**2.3 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- E. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.

**3.2 INSTALLATION**

- A. Conform to drawing details:
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight with high quality NS silicone sealant.
- F. Install components in accordance with manufacturer's instructions.
- G. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- H. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

076200-2

**SECTION 078413 - PENETRATION FIRESTOPPING**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

1.02 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.03 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

Only tested firestop systems shall be used in specific locations as follows:

- A. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- B. Blank openings through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- C. Openings and penetrations in fire-rated partitions or walls containing fire doors.
- D. Openings around structural members which penetrate floors or walls.

1.04 RELATED WORK OF OTHER SECTIONS

- A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
  - 1. Section 03 30 00 - Cast-In-Place Concrete
  - 2. Section 07 84 43 - Joint Firestopping
  - 3. Section 07 90 00 - Joint Protection
  - 4. Section 09 21 16 - Gypsum Board Assemblies
  - 5. Section 22 00 00 - Plumbing
  - 6. Section 23 00 00 - Heating, Ventilating, and Air Conditioning
  - 7. Section 26 00 00 - Electrical

1.05 REFERENCES

- A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops"
- B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops"
- C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Firestop Devices (XHJI)

**SECTION 078413 - PENETRATION FIRESTOPPING**

- b. Fire Resistance Ratings (BXRH)
  - c. Through-Penetration Firestop Systems (XHEZ)
  - d. Fill, Voids, or Cavity Material (XHHW)
  - e. Forming Materials (XHKU)
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
  - E. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - F. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops."
  - G. All major building codes: IBC and Building Code of New Jersey.
  - H. NFPA 101 - Life Safety Code
  - I. NFPA 70 - National Electric Code

1.06 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide through-penetration fire stop systems that comply with specified requirements of tested systems.
- B. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. 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.

1.07 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of qualified firestop systems to be used and manufacturer's installation instructions.
- B. Manufacturer's engineering judgment identification number and drawing details when no qualified tested system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in document.
- D. Submit safety data sheets provided with product delivered to job-site.

1.08 DELIVERY, STORAGE, AND HANDLING

**SECTION 078413 - PENETRATION FIRESTOPPING**

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.09 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

**PART 2 - PRODUCTS**

2.01 FIRESTOPPING - GENERAL

- A. 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 the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
  - 1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- D. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

**SECTION 078413 - PENETRATION FIRESTOPPING**

- E.
  - 1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
  - 2. 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.
- F. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
  - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- G. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturer as identified below:
  - 1. Hilti, Inc., Plano, Texas
  - 2. Specified Technology Inc.
  - 3. 3M Fire protection Products
  - 4. Approved Equal

2.03 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-formed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors.
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
- D. Sealants or caulking materials for use with sheet metal ducts.
- E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.
- F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.
- G. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles.
- H. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes.
- I. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems).

**SECTION 078413 - PENETRATION FIRESTOPPING**

Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways.

- J. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways.
- K. Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.
- L. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits or cables is expected.
- M. For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.

**PART 3 - EXECUTION**

**3.01 PREPARATION**

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - 5. Do not proceed until unsatisfactory conditions have been corrected.

**3.02 COORDINATION**

- A. Coordinate construction of openings, penetrations and construction joints to ensure that the fire stop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Coordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- C. Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.
- D. Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

**3.03 INSTALLATION**

- A. Install in strict accordance with manufacturer's detailed installation instructions and procedures.

**SECTION 078413 - PENETRATION FIRESTOPPING**

- B. Install so that openings are completely filled and material is securely adhered.
- C. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- D. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- E. Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.
- F. At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
- G. Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
- H. Notify Authority Having Jurisdiction (AHJ) when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- I. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

**3.04 FIELD QUALITY CONTROL**

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.

**3.05 ADJUSTING AND CLEANING**

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.
- C. Install identification Labels for Through Penetration: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
  - 1. The words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage."
  - 2. Listing agency's system number or designation.
  - 3. System manufacturer's name, address, and phone number.
  - 4. Installer's name, address, and phone number.
  - 5. General contractor's name, address, and phone number (if applicable).
  - 6. Date of installation.

END OF SECTION



**SECTION 079200 - JOINT PROTECTION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Sealants and joint backing.

**1.2 REFERENCES**

- A. ASTM C834 - Standard Specification for Latex Sealants; 2005.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2005a.

**1.3 SUBMITTALS**

- A. See General Conditions article 4.7 or submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, 3/8 x 10 inches in size illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

**1.4 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years' experience.

**1.5 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

**1.6 COORDINATION**

- A. Coordinate the work with all sections referencing this section.

**1.7 WARRANTY**

- A. Correct defective work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Sealants:
  - 1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 2. Tremco, Inc.: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 3. Sika USA
  - 4. Dow Corning
  - 5. Approved Equal

**SECTION 079200 - JOINT PROTECTION**

**2.2 SEALANTS**

- A. Sealants and Primers
- B. Type A - General Purpose Exterior Sealant: Premium –grade high performance 1 component silicone based non-sag elastomeric sealant.
  - 1. Color: Colors matching finished surfaces.
  - 2. Product: DOW Corning 795 Building Silicone sealant or equal.
  - 3. Primer: As per manuf. porous materials require priming primer P or equal
  - 4. Approved Equal

**2.3 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.
- C. In General all sources of air leakage in exterior building envelope shall be sealed by caulking or weather stripping.

**3.2 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

**3.3 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges.
- G. Tool joints concave.

**SECTION 079200 - JOINT PROTECTION**

**3.4 CLEANING**

- A. Clean adjacent soiled surfaces.

**3.5 PROTECTION**

- A. Protect sealants until cured.

END OF SECTION

**SECTION 081113 HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Thermally insulated steel doors.

**1.2 RELATED SECTIONS**

- A. 087100 – Door Hardware.
- B. 099000 – Paints and Coatings: Field painting.

**1.3 REFERENCES**

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2006a.
- E. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- F. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).
- G. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 1999.
- H. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2000.
- I. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- J. Safety Standard for Architectural Glazing Materials (16 CFR 1201) CI and CII issued by the Consumer Product Safety Commission
- K. ANSI Z 97.1, "Safety Glass Test Requirements".

**1.4 SUBMITTALS**

- A. See Section 4.7 of General Conditions for submittal procedures.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

**SECTION 081113 HOLLOW METAL DOORS AND FRAMES**

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Steel Doors and Frames:
  - 1. Ceco Door Products: [www.cecodoor.com](http://www.cecodoor.com).
  - 2. Windsor Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft: [www.steelcraft.com](http://www.steelcraft.com).
  - 4. Approved Equal.

**2.2 DOORS AND FRAMES**

- A. Requirements for All Doors and Frames:
  - 1. Accessibility: Comply with ANSI/ICC A117.1.
  - 2. Door Top Closures: Flush with top of faces and edges.
  - 3. Door Edge Profile: Beveled on both edges.
  - 4. Door Texture: Smooth faces.
  - 5. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
  - 6. Galvanizing for Units in Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
  - 7. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

**2.3 STEEL DOORS**

- A. Exterior Doors:
  - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless. 16 gage.
  - 2. Core: Polyurethane.
  - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
  - 4. Weatherstripping: Separate, see Section 08 7100.
- B. Interior Doors, Non-Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush. 16 gage.
  - 2. Thickness: 1-3/4 inches.

**2.4 STEEL FRAMES**

- A. General:
  - 1. Comply with the requirements of grade specified for corresponding door.
    - a. ANSI A250.8 Level 2 Doors: 16 gage frames.
    - b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 gage
  - 2. Finish: Factory primed, for field finishing.

**SECTION 081113 HOLLOW METAL DOORS AND FRAMES**

3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
  4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high (as indicated on drawings) to fill opening without cutting masonry units.
- B. Exterior Door Frames: Fully welded.  
Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.  
Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire-Rated: Face welded type.

**2.5 ACCESSORY MATERIALS**

- A. Louvers: Roll formed steel with overlapping frame; sightproof inverted V blade style; finish same as door components.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

**2.6 SAFETY GLAZING**

- A. All glazing in non-rated doors subject to human impact loads shall be ¼" tempered glass or laminated safety glass.
- B. Impact Test: all safety glazing to be tested in accordance with impact safety standard CPSC 16CFR 1201 and comply with the test criteria for Category I or II as applicable.
- C. Glass Identification: Each pane of safety glass installed shall be identified by a manufacturer's designation specifying who applied the designation, the manufacturer or installer of the safety glass.
  - 1) Tempered and heat strengthened glass shall bear the manufacturer's identification as to type and thickness.
  - 2) Manufacturer's and UL identifications for glazing shall be permanently etched so as to be visible after glass has been set in place and glazed. The identification mark shall be acid etched, laser etched, embossed or of a type that once applied cannot be removed without being destroyed.
  - 3) Glass other than tempered, heat strengthened and UL-marked glass shall not have labels.

**2.7 FINISH MATERIALS**

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

**SECTION 08 1407 – COMMERCIAL WOOD DOORS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior painted flush wood doors.
  - 2. Interior laminate-faced wood doors.
- B. Related Requirements:
  - 1. Hollow metal frames for wood doors.
  - 2. Door hardware.
  - 3. Site painting.

**1.2 PREINSTALLATION MEETINGS**

- A. Conduct pre-installation meeting at Project site.
- B. Discussion Topics:
  - 1. Delivery, storage, and handling.
  - 2. Coordination with hardware **[and access control]** installers.
  - 3. Protection of installed doors.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Each type of door and finish.
  - 1. Core and edge construction.
  - 2. Fire rated doors.
  - 3. Glazed openings.
  - 4. Louvers.
  - 5. Finishes.
- B. Shop Drawings and Schedule:
  - 1. Use same unit designations used in Contract Documents.
  - 2. Hardware preparation.
  - 3. Glazed openings.
  - 4. Louvers.

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### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Manufacturer warranties transferrable to Owner.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: Certified for chain of custody by an FSC-accredited certification body.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package factory-finished doors individually in manufacturer's standard plastic bags, stretch wrap, or cardboard cartons.
- B. Store doors inside building in clean, dry location.
- C. Mark each door on top rail with opening number used on Shop Drawings.

### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity at occupancy levels during remainder of construction period.

### 1.8 MANUFACTURER WARRANTIES

- A. Standard manufacturer warranties.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch (6 mm) in 42-by-84-inch (1065-by-2130-mm) section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in 3-inch (0.25 mm in 76-mm) span.
  - 2. Solid Core Doors: Limited lifetime warranty.
  - 3. Hollow Core Doors: Limited one year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Products of Cendura™ Series | Mohawk by Masonite Architectural are specified to indicate requirements for quality and appearance.



1. Website: [Masonite.com/architectural/products/cendura-series](https://www.masonite.com/architectural/products/cendura-series)
  2. Phone: 877.332.4484
- B. Subject to compliance with requirements, equivalent products of the following manufacturers will be acceptable.
1. Tru door
  2. Or approved equal
- C. Source Control: Supply all wood doors from a single manufacturer.

## 2.2 MANUFACTURING STANDARD

- A. Interior Wood Doors: Window & Door Manufacturers Association publication ANSI/WDMA I.S. 1A "Industry Standard for Interior Architectural Wood Flush Doors".
- B. Fire-Rated Wood Doors: Conforming to NFPA 80; listed and labeled for required ratings based on testing at positive pressure NFPA 252 or UL 10C by UL or other testing agency acceptable to authorities having jurisdiction
1. Blocking: Provide composite blocking approved for use in doors of fire-protection ratings indicated as needed to maintain WDMA performance level and eliminate through-bolting hardware.

## 2.3 SUSTAINABILITY REQUIREMENTS

- A. Adhesives: Meeting testing and product requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Composite Wood Products: Manufactured with ultra-low-emitting formaldehyde resins as defined in California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or with no added formaldehyde.

## 2.4 INTERIOR SOLID CORE STANDARD PAINTED FLUSH WOOD DOORS

- A. Basis of Design: Cendura™ Series | Mohawk by Masonite Architectural.
- B. Solid Core Standard Painted Flush Doors
1. WDMA Quality Standard: Custom.
  2. WDMA Performance Level: **Heavy Duty**.
  3. Faces: **Paint grade birch**.
  4. Vertical Edges: Finger-Jointed Softwood/Mill Option low density hardwood.
  5. Horizontal Edges: Structural Composite Lumber
  6. Core: **[Wood based particleboard.]**
  7. Construction: Five plies. Stiles and rails are bonded to core, and then entire unit is abrasive planed before veneering.
  8. Thickness: **[1-3/4 inch.]**

- C. Fire-Rated Standard Painted Solid-Core Flush Doors
  - 1. Match appearance grade and applicable construction and performance requirements of other paint finish flush wood doors.
  - 2. Rating: **as specified**
  - 3. Core:
    - a. 20-Minute Doors: **[Wood-based particleboard core.]**
    - b. 45-Minute Doors: **[Fire resistant particleboard core.]**
    - c. 60-, 90-Minute Doors: Mineral core.
  - 4. Vertical Edges:
    - a. 20-Minute Doors: Mill option softwood or low-density hardwood.
    - b. 45-Minute Fire Resistant Particleboard Core Doors: Veneer edge-band over fire stile.
    - c. 45-, 60-, 90-Minute Mineral Core Doors: Hardwood composite fire stile.
  - 5. Horizontal Edges:
    - a. 20-Minute Doors: Structural composite lumber.
    - b. 45-, 60-, 90-Minute Doors: Manufactures standard construction per label service listing.

## **2.5 FABRICATION**

- A. Factory Prime all surfaces and paint per finish schedule.
- B. Factory Fitting: Fit to frame openings with clearances specified in WDMA I.S. 1A.
  - 1. Undercut: Maximum **3/8 inch (10 mm)** above thresholds.
  - 2. Fire-Rated Doors: Comply with NFPA 80.
- C. Factory Machining: Machine doors for hardware that is not surface applied.
  - 1. Verify dimensions for hardware mortises in metal frames before machining.
- D. Openings:
  - 1. Cut and trim openings and install glazing at factory.
  - 2. Cut openings and install louvers at factory.
- E. Door Frames:
  - 1. See hollow metal frames.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that door frames are plumb, square, and accurate size.

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- B. Inspect each door before installation for damage and defects per WDMA Section F-6.

### **3.2 INSTALLATION**

- A. Hardware installation is specified in Section 08 7100 – Door Hardware.
- B. Reference Standards:
  - 1. Wood Doors: **[WDMA I.S. 1A]**.
  - 2. Fire-Rated Doors: NFPA 80.
  - 3. Smoke-and Draft-Control Doors: NFPA 105.
- C. Align doors with uniform vertical and top edge clearance.

### **3.3 REPAIR**

- A. Repair of damage or defects is subject to Architect's acceptance, including removal of soiling.
- B. Provide new replacement doors for doors that cannot be satisfactorily repaired.

### **3.4 PROTECTING AND CLEANING**

- A. Protect installed doors from damage and soiling.
- B. Clean doors shortly before inspection for Substantial Completion.

**END OF SECTION**

**SECTION 081113 HOLLOW METAL DOORS AND FRAMES**

**3.2 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

**3.3 INSTALLATION**

- A. Install in accordance with the req. of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Coordinate installation of hardware.
- E. Coordinate installation of electrical connections to electrical hardware items.

**3.4 ERECTION TOLERANCES**

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

**3.5 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**3.6 SCHEDULE - See Drawings**

**END OF SECTION**

**SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

**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 Kawneer Aluminum Entrances, glass and glazing, and door hardware and components.
  - 1. Types of Kawneer Aluminum Entrances include.
    - a. 500 Heavy Wall™ IR Swing Door; Wide stile, 5" (127 mm) vertical face dimension, 2" (51 mm) depth, 3/16" (5 mm) wall thickness high traffic applications.
- B. Related Sections.
  - 1. 072700 "Air Barriers".
  - 2. 079200 "Joint Sealants".
  - 3. 083213 "Sliding Aluminum-Framed Glass Doors".
  - 4. 084313 "Aluminum-Framed Storefronts".
  - 5. 085113 "Aluminum Windows".
  - 6. 086300 "Metal-Framed Skylights".
  - 7. 087000 "Hardware".
  - 8. 088000 "Glazing".
  - 9. 280000 "Electronic Safety and Security".

**1.3 Definitions**

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

**1.4 Performance Requirements**

- A. General Performance: Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Aluminum-Framed Entrance Performance Requirements.
  - 1. Wind loads: Provide aluminum-framed entrance door system; include anchorage, capable of withstanding wind load design pressures of the subject site location. The design pressures shall be based on the 2015 International Building Code.
  - 2. Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 1.57 psf (75 Pa) for single doors and for pairs of doors. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft<sup>2</sup>. A pair of 6'0" x 7'0" (1830 mm x 2134 mm) entrance doors and frame shall not exceed 1.0 cfm/ft<sup>2</sup>.
  - 3. Structural Performance: Corner strength shall be tested per the Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity [Testing procedure and certified test results available upon request].

**SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

4. Uniform Load: A static air design load of 85 psf (4070 Pa), (65 psf (3113 Pa) for laminated infill) shall be applied in the positive and negative direction in accordance with Florida Building Code TAS202 and ASTM E 330. There shall be no deflection in excess of L/180 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage shall occur.
5. Windborne-Debris-Impact Resistance Performance: Shall be tested in accordance with ASTM E1886, information in ASTM E1996, and TAS 201/203.
  - a. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1m) of grade.
  - b. Small-Missile Impact: For aluminum-framed systems located above 30 feet (9.1 m) of grade.
6. Blast Mitigation Performance: Shall be tested or proven through analysis to meet ASTM F1642, GSA-TS01, and UFC 04-010.01 performance criteria.

To meet UFC 04-010-01, B-3.1 Standard 10 for Windows and Skylights, the following options are available:

  - a. Section B-3.1.1 Dynamic analysis.
  - b. Section B-3.1.2 Testing.
  - c. Section B-3.1.3 ASTM F2248 Design Approach.
7. Forced Entry: Tested in accordance with AAMA 1304.

**1.5 Submittals**

- A. Product Data: Include construction details, material descriptions, and fabrication methods, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed entrance door indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed entrance door and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed entrance doors.
- F. Fabrication Sample: Corner sample consisting of a door stile and rail, of full-size components and showing details of the following.
  1. Joinery, including welds.
  2. Glazing.
- G. Other Action Submittals.
  1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

**1.6 Quality Assurance**

**SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum-framed entrance doors and storefronts that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum-framed entrance doors through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed entrance doors and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

**1.7 Project Conditions**

- A. Field Measurements: Verify actual dimensions of aluminum-framed entrance door openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

**1.8 Warranty**

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
  - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

**PART 2 - PRODUCTS**

**2.1 Manufacturers**

- A. Basis-of-Design Product:
  - 1. Kawneer Company Inc..
  - 2. The door stile and rail face dimensions of the entrance door will be as follows:

Door	Vertical Stile	Top Rail	Bottom Rail	Optional
500 Heavy Wall™ IR	5" (127 mm)	5" (127 mm)	6-1/2" (166 mm)	10" (254 mm)
  - 3. Major portions of the door members to be 0.188" (5 mm) nominal in thickness and glazing molding to be 0.05" (1.5 mm) thick.
  - 4. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
  - 5. (350/500 Heavy Wall™) Provide adjustable glass jacks to help center the glass in the door opening.
  - 6. (350/500 Heavy Wall™ IR) Structural silicone sealant to be DOW 995 or Tremco Proglaze SSG.
- B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.

**SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

1. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid aluminum-framed entrance door installation and construction delays.
  2. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
  3. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for aluminum-framed entrance door system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum-framed entrance doors for a period of not less than ten (10) years. (Company Name)
  4. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
  5. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

**2.2 Materials**

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (3 mm) wall thickness at any location for the main frame and door leaf members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed entrance door members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
  1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

**2.3 Storefront Framing System**

- A. Storefront Entrance Framing.
  1. Trifab™ 450/451/451T.
- B. Non-Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.



## SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle aluminum-framed entrance door material and components to avoid damage. Protect aluminum-framed entrance door material against damage from elements, construction activities, and other hazards before, during and after aluminum-framed entrance door installation.

### 2.4 Glazing

- A. Glazing: As specified in Division 08 Section "Glazing".
  - 1. 350/500 Heavy Wall IR: 9/16" (14.3 mm) laminated infill with 0.090" (3 mm) PVB interlayer.
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

### 2.5 Hardware

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
- B. Standard Hardware (**350/500 Heavy Wall™**). – coordinate with door schedule and security drawings
  - 1. Weather-stripping.
    - a. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
    - b. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
  - 2. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (Necessary to meet specified performance tests).
  - 3. Threshold: Extruded aluminum, one piece per door opening, with ribbed surface.
  - 4. Continuous hinges: Ives
  - 5. Exit Device: VonDuprin.
  - 6. Closer: LCN.
- C. Access Control Entrance Hardware. – see security drawings
  - 1. Proximity Cards.
  - 2. Exit Device: Von Duprin
  - 3. Power supply for Exit Device:
  - 4. Power supply for Electric Strike:
  - 5. Power Transfer hinge. One per EL Exit Device required for access control.
  - 6. Point to Point wiring diagram.

### 2.6 Fabrication

- A. Fabricate aluminum-framed entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

## SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

- B. Fabricate aluminum-framed entrance doors that are reglazable without dismantling perimeter framing.
  - 1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
  - 2. Accurately fit and secure joints and corners. Make joints hairline in appearance.
  - 3. Prepare components with internal reinforcement for door hardware.
  - 4. Arrange fasteners and attachments to conceal from view.
- C. Weather-stripping: Provide weather-stripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.

### 2.7 Aluminum Finishes

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing.
  - 1. Kawneer #14 CLEAR Anodized Aluminum AA-M10C21A41 / AA-M45C22A41 Architectural Class I (.7 mils minimum)).

## PART 3 - EXECUTION

### 3.1 Examination

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated installation.
  - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
  - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
  - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 Installation

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.
- B. Install aluminum-framed entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill threshold in bed of sealant, as indicated, for weather tight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.3 Field Quality Control

**SECTION 084113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

- A. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

**3.4 Adjusting, Cleaning, and Protection**

- A. Clean aluminum surfaces immediately after installing aluminum-framed entrances. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

**END OF SECTION 084113**

**SECTION 087100 DOOR HARDWARE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Furnishing of all items of finish hardware as hereinafter specified or obviously necessary to complete the building, except those items which are specifically excluded from this section of the specifications.

**1.2 RELATED SECTIONS**

- A. The following sections of this specification should be examined in order to identify materials or equipment which may be obtained through this section:
  - 1. 08 1113 – Hollow Metal Doors and Frames
  - 2. 08 1416 – Flush Wood Doors

**1.3 DESCRIPTION OF WORK**

- A. "Finish Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame. Extent of finish hardware required is indicated on drawings and in schedules. Types of finish hardware required include the following:
  - 1. Butt Hinges
  - 2. Lock cylinders and keys
  - 3. Lock and latch sets
  - 4. Exit Devices
  - 5. Push/pull units
  - 6. Closers
  - 7. Protection plates
  - 8. Weatherstripping for exterior doors
  - 9. Thresholds
  - 10. Silencers

**1.4 REFERENCES**

- A. Finish hardware in this section shall meet the following standards as established by the American National Standards Institute, Inc. (ANSI) which is sponsored by the Builders Hardware Manufacturers Association, Inc. (BHMA). Product tests are to be administered by the ETL Testing Laboratories, Inc., Underwriters Laboratories, or other official testing laboratories which have been designated by BHMA for the testing of ANSI standards. The standards latest revision will be in effect.
- B. Materials & Finishes
  - 1. Butts & Hinges ANSI A156.1 Grade 1
  - 2. Locks & Lock Trim ANSI A156.2 Grade 1
  - 3. Exit Devices ANSI A156.3 Grade 1
  - 4. Door Controls - Closers ANSI A156.4 Grade 1
  - 5. Auxiliary Lock & Assoc. Products ANSI A156.5 Grade 1
  - 6. Architectural Door Trim ANSI A156.6
  - 7. Template Hinge Dimensions ANSI A156.7
  - 8. Door Controls - Overhead Holders ANSI A156.8 Grade 1
  - 9. Cabinet Hardware ANSI A156.9
  - 10. Cabinet Locks ANSI A156.11 Grade 1
  - 11. Mortise Locks & Latches ANSI A15
  - 12. Auxiliary Hardware
- C. Listed Hardware—Hardware which is to be installed in or on fire labeled doors and frames, Class A or lesser, single or pairs, shall be tested and listed by Underwriters Laboratories and/or Warnock Hersey Laboratories Division. Exit devices which are to be used as panic hardware shall be tested and listed

**SECTION 087100 DOOR HARDWARE**

in Underwriters Laboratories "Accident Equipment List - Panic Hardware". All listed hardware shall be in compliance with National Fire Protection Association Number 80 and be properly stamped or labeled for easy identification.

**1.5 SUBMITTALS**

- A. See section 4.7 for submittal procedures.
- B. After the award of a formal contract, A completed typewritten copy of the proposed Finish Hardware Schedule shall be submitted to the Architect for approval. This schedule shall be prepared using the "Sequence and Format for the Hardware Schedule" as approved and recommended by the Door and Hardware Institute (DHI). After approval of the schedule, the Hardware Supplier shall provide two (2) copies of the approved schedule to the Architect for file and distribution purposes.
- C. When submitting schedules for approval, include three (3) sets of manufacturers' cut sheets on hardware item proposed.
- D. Templates—The Hardware Supplier shall provide necessary templates and/or physical hardware to all trades requiring them in order to cut, reinforce, or otherwise prepare their material or product to receive the hardware item. In the event that physical hardware is required by any manufacturer, the Hardware Supplier shall ship to them such hardware via prepaid freight in sufficient time to prevent any delay in execution of their work.

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. All items of hardware to be delivered to the job site shall be completely packaged with all necessary screws, bolts, miscellaneous parts, instructions, and where necessary, installation templates for manufacturers' suggested installation. They are to be clearly labeled so as to conveniently identify them and their intended location in the building.
- B. A representative of the General Contractor shall receive the hardware when delivered at the job site. A dry, locked storage space, complete with shelving, shall be set aside for the purpose of unpacking, sorting out, checking and storage.
- C. Finish hardware shall be delivered to the General Contractor by the Hardware Supplier. Direct factory shipments to the job site are not acceptable.
- D. The hardware shall be jointly inventoried by representatives of the General Contractor and the Hardware Supplier.
- E. Items damaged prior to acceptance by General Contractor shall be replaced promptly with proper material, and without additional cost to the General Contractor.
- F. All hardware shall be handled in a manner to minimize marring, scratching, or damage.

**PART 2 - PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. Requirements for design, grade, function, finish, size, and other distinctive quantities of each type of finish hardware are indicated in the hardware schedule, Drawing A6.01.

**2.2 FINISH OF HARDWARE**

- A. Finish of hardware items shall be listed in the hardware schedule and shall conform to ANSI A156.18 unless other specified.

**SECTION 087100 DOOR HARDWARE**

**2.3 HINGES**

- A. Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template hinges which conform to ANSI whenever applicable.
- B. Use ball bearing hinges on heavy doors, doors where high frequency service is expected and doors equipped with door closers.
- C. All butt hinges to be used on exterior doors or doors subject to special atmospheric conditions shall be Stainless Steel.
- D. Hinge pins, except as otherwise indicated, shall be as follows:
  - 1. Steel hinges—Steel pins.
  - 2. Non-ferrous hinges—Stainless Steel pins.
  - 3. Exterior doors—Non-removable pins (NRP) or security stud.
  - 4. Interior doors—Non-rising pins.
  - 5. Tips—Flat button and matching plug, finished to match leaves, except where hospital tip is indicated.
- E. Size of hinges shall be as follows:
- F. 

Door Thickness	Width	Hinge Height	Hinge Width
1-3/4"	to 36"	4½"	4" or 4½"
1-3/4"	over 36"	5"	4½" Extra Heavy Ball Bearing
- G. Numbers of hinges per door, provide quantities as follows:
  - 1. For doors less than 5 feet high—1 pair.
  - 2. For doors 5 feet to 7 feet 6 inches high—1½ pair and one addition hinge for each additional 2½ feet of door height or fraction thereof.
- H. When projection of door trim is such as to prevent desired degree of opening, the proper hinge width shall be provided to allow the door to clear the trim.
- I. It is the responsibility of the Finish Hardware Supplier to field verify all existing frames and submit hardware schedule indicating hinge sizes compatible with existing frames.
- J. Basis of Design hinges are by Stanley.
- K. Acceptable manufactures are Ives, Bommer, Hagger or Approved Equal

**2.4 LEVER HANDLE LOCKSETS LATCHSETS AND CYLINDERS**

- A. All locks and cylinders are to be by the same manufacturer.
- B. Mechanical locksets for this project shall be Mortise type with lever handle trim as specified.
- C. The lockset case shall be manufacturer's standard wrought steel with zinc dichromate finish.
- D. Strikes shall be curved lip stainless steel ANSI Standard A115.1, 4-7/8"x1-1/4". Provide straight lip strikes, 7/8" lip to center, at pairs of doors.
- E. Provide cylinders with keyed-alike cores as specified in the hardware sets at the end of this section.
- F. Locksets for labeled fire doors shall have a fusible link or other mechanism to prevent latchbolt retraction in the event of fire.
- G. Scheduled locksets, latchsets, and cylinders are: Yale.
- H. Acceptable manufactures are Schlage, Corbin Russwin, Hagger or Approved Equal

**2.5 EXIT DEVICES**

- A. All exit devices for this project shall have the chassis, end cap, and horizontal mounting rail, mounted directly to, and flush with, the door surface. No gaps or space shall be permitted between the back of

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the horizontal mounting rail and the door surface. If required, a continuous solid spacer bar shall be used to fill the space between the back of the device and the door surface.

- B. The touch pad shall retract the latchbolt by means of a sliding motion of the touch pad activating the level arm for easy operations and reduced friction.
- C. Trim for exit devices shall be either pull or lever type by exit device manufacturer as specified.
- D. All exit devices shall carry manufacturer's one-year warranty.
- E. Basis of Design is scheduled as Von Duprin.
- F. Acceptable manufactures are Falcon, Corbin Russwin, Adams Rite or Approved Equal

**2.6 DOOR CLOSERS**

- A. All door closers for this project shall be the product of one of the manufacturer and shall have cast iron cases.
- B. Door closers shall be full rack and pinion type construction, non-handed and adjustable spring power in accordance with ANSI A117.1 handicapped code.
- C. All closers shall have separate adjustable, non-critical key control valves, one each for the following:
  - 1. Closing speed
  - 2. Latching speed
  - 3. Backcheck and/or delayed action
- D. The spindle shall be heavy duty heat treated steel construction.
- E. The installing contractor shall be responsible for proper installation of door closers in accordance with degree of opening indicated on hardware schedule. The installing contractor shall be responsible for adjustment of the three individual valves, for proper control as follows:
  - 1. Closing speed
  - 2. Latching speed
  - 3. Delayed action, or backcheck
- F. All door closers shall be listed by Underwriters Laboratories for use on self-closing fire rated doors.
- G. All door closers shall carry a ten-year (10) year warranty.
- H. Scheduled door closers are by LCN.
- I. Acceptable manufactures are Norton, Hagar, Sargent or Approved Equal

**2.7 STOPS**

- A. Stops shall be supplied for all doors not equipped with a holding or stay device. They shall control the desired limit of opening, helping to prevent damage to adjacent walls, columns, equipment, the door or its hardware.
- B. Overhead stops shall be used where specified, or where floor stops cannot be used. Where specified, provide overhead stops which incorporate field adjustability between 85 and 110 degrees of door opening. Plastic end caps at overhead stops are not acceptable.
- C. All stops to be fastened to concrete shall use expansion shields and machine screws.
- D. Basis of design floor stops are by Ives.
- E. Acceptable manufactures are Rockwood, Hagar, or Approved Equal

**2.8 KICKPLATES**

- A. Kickplates shall be .050 thickness stainless, as required for scheduled finish, specified height by specified width.

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- B. Kickplates shall be applied on the push side and/or pull side of all doors where noted.
- C. All kickplates to be beveled four sides.
- D. Basis of Design kickplates are Ives.
- E. Acceptable manufactures are Rockwood, Hagar, or Approved Equal

**2.9 Kickdown Hold Open**

- A. Kickdown Door Holder shall be constructed from Cast Brass or Aluminum Construction.
- B. Basis of Design Hold Open is by Ives.
- C. Acceptable manufactures are Rockwood, Hagar, or Approved Equal.

**2.10 SEALS**

- A. Seals shall be manufactured from nylon brush insert with all extruded aluminum retainer. Seals shall designed to be installed on metal or wood door frames.
- B. Scheduled seals are by Pemko.
- C. Acceptable manufactures are Zero, Reese or Approved Equal.

**2.11 THRESHOLDS**

- A. Except as scheduled otherwise, thresholds shall be flat saddle thermal barrier type, handicap accessible to meet ANSI 117.1 1980. Include machine screws with lead expansion shields for installation.
- B. Finish of thresholds is to be mill finish aluminum.
- C. Basis of Design by Pemko.
- D. Acceptable manufactures are Zero, Reese or Approved Equal.

**2.12 FLUSHBOLTS**

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
- B. Finish of thresholds is to be satin stainless steel.
- C. Basis of Design by Ives.
- D. Acceptable manufactures are Glynn Johnson, Rockwood, Hagar or Approved Equal.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware" for Standard Steel Doors and Frames, Custom Steel Doors and Frames, Wood Doors and Frames by the Door and Hardware Institute (DHI), except if otherwise specifically indicated or to comply with requirements of governing regulations, requirements for the handicapped
- B. Degree of opening for doors with overhead holders, closers, etc., shall be included in the hardware schedule for the Architect's approval.
- C. All hardware shall be installed by tradesmen skilled in the application of commercial grade hardware.



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- D. Install each hardware item in compliance with the instructions and recommendations. Securely fasten all parts to be attached. Fit faces of mortised parts snug and flush. Make sure all operating parts move freely and smoothly without binding, sticking or excessive clearance. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, the hardware shall be removed and stored prior to the painting or finishing. Items shall then be reinstalled only when the finishes have been completed on the surface to which the hardware is to be applied.
- E. To maintain warranties and preserve fire-ratings, fasteners used for installation are to be those provided with respective hardware items by hardware manufacturer. Self-drilling, self-tapping "TEK" screws are not to be used for any item of hardware unless packaged with hardware item by manufacturer.
- F. At exterior doors and elsewhere as indicated, set thresholds in a bed of sealant as specified in Section 079200 to completely fill concealed voids and exclude moisture from every source. Do not plug drain holes or block weeps. Remove excess sealant.
- G. After installation, representative templates, instruction sheets and installation details shall be placed in a file folder to be turned over to the Owner when the building is accepted. Included shall be at least five (5) each of any special adjusting and/or installation tools furnished with the hardware by the manufacturer.

**3.2 ADJUSTING AND CLEANING**

- A. Adjust and check each operating item of hardware to ensure correct operation and function. Units which cannot be adjusted to operate as intended for the application made shall be replaced.
- B. Final adjustment: Whenever hardware is installed more than one month prior to building acceptance or occupancy of a space or area, the installer shall return to the work during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items. Hardware shall be cleaned as necessary to restore correct operation, function, and finish. Door control devices shall be adjusted to compensate for the final operation of heating and ventilating equipment.

**3.3 PROTECTION**

- A. Whenever hardware is located in areas where it may be subject to damage during construction by handling, cleaning, etc., (i.e., painting, cleaning of bricks) it shall be protected and/or removed from its location until the hazardous condition is terminated.

**END OF SECTION**

**SECTION 092116 GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior Gypsum board.
- B. Related Sections:
  - 1. 072116 – Blanket Insulation.
  - 2. 05 4000 - Cold-Formed Metal Framing
- C. Drawings, the provisions of the Agreement, the General Conditions, and Division 1 specification sections apply to work of this Section.

**1.2 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. C475 - Joint Treatment Materials for Gypsum Wallboard Construction.
  - 2. C557 - Adhesives for Fastening Gypsum Wallboard to Wood Framing.
  - 3. C931 - Standard Specification for Exterior Gypsum Soffit Board.
  - 4. C1002 - Steel Drill Screws for the Application of Gypsum Board.
  - 5. C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
  - 6. C1278 - Specification for Fiber Reinforced Gypsum Panels.
  - 7. C1395 - Specification for Gypsum Ceiling Board
  - 8. C1396 - Specification for Gypsum Board
  - 9. D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- B. Gypsum Association (GA):
  - 1. GA-214 - Recommended Levels of Gypsum Board Finish.
  - 2. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
- C. Northwest Wall and Ceiling Bureau (NWCB): LFGB-398 - Recommended Levels for Finishing of Gypsum Board.
- D. Underwriters Laboratories (UL) 752 - Standard for Bullet Resisting Equipment.

**1.3 SUBMITTALS**

- A. See General Conditions Article 4.7 for submittal procedures.
- B. Submit complete manufacturer's product literature and installation instructions for each of the materials used.

**1.4 QUALITY ASSURANCE**

- A. Perform work in accordance with GA 216, unless specified otherwise, or required otherwise to meet fire rating requirements.
- B. Regulatory Requirements:
  - 1. Provide assemblies meeting the hourly fire ratings indicated and specified. Assemblies shall be approved by the local jurisdictional authorities.
  - 2. Fire rating requirements take precedence over the construction requirements indicated. In the event of conflict, notify the Architect, and do not begin construction in the area of conflict until the conflict has been resolved.

**SECTION 092116 GYPSUM BOARD**

**PART 2 - PRODUCTS**

**2.1 GYPSUM BOARD MATERIALS**

- A. Furnish boards of maximum permissible length for type of installation indicated, tapered edge for boards to be exposed, taped and finished; square edge for boards in concealed applications; 5/8 inch thick unless noted or specified otherwise; furnish type X for fire rated partitions.
- B. Types:
  - 1. General Wall Areas: Mold Resistant Gypsum Board:
    - a. comply with ASTM C1396 or ASTM C1177; 5/8 inch thickness; Type "X." Back shall be resistant to mold and mildew growth; average score of not less than 8 when tested in accordance with ASTM D3273.
  - 2. Ceiling Board: ASTM C1395; sag resistant
- C. Manufacturer
  - a. USG Corporation "Mold Tough AR Firecode Core,"
  - b. Georgia Pacific "DensArmor Fireguard Interior Guard",
  - c. National Gypsum Co. "Gold Bond Brand XP Fire-Shield Wallboard,"
  - d. Approved Equal

**2.2 ACCESSORIES**

- A. Adhesive for laminated construction: ASTM C557, unless recommended otherwise by the gypsum board manufacturer.
- B. Interior Gypsum Trim:
  - 1. Conform to GA 216, unless indicated or specified otherwise.
  - 2. Concealed flange crimp-on or tape-on type; metal or PVC at Contractor's option.
  - 3. Control Joint Trim: USG 093 or approved.
  - 4. Reveal Moldings: Fry Reglet Co., Pittcon Industries, Inc., Gordon Inc, or approved; aluminum extrusions with taping flanges; shapes as indicated.
- C. Joint Tapes:
  - 1. Standard: ASTM C475 and GA 216.
  - 2. Mesh Tape for Water Resistant Backing Board: 2-1/2 inch wide glass fiber tape; 10x10 mesh; self adhesive type.
- D. Joint Compound, Tape, and Finishing Compound: ASTM C475; furnish setting type joint compound for use at water resistant board.
  - 1. Typical: USG "SHEETROCK Brand Taping, All-Purpose, and/or Topping Compound," or approved.
  - 2. Setting Type: USG "SHEETROCK Brand Easy Sand Setting-Type Joint Compound," or approved.
- E. Screws: ASTM C1002.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not begin work until unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

## SECTION 092116 GYPSUM BOARD

### 3.2 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with GA 216, and fire rated assembly requirements.
- B. Erect wallboard so that edges and corners are firmly supported.
- C. Use screws to fasten gypsum board to metal furring or framing. Adhesive application of gypsum board may be used if it is in accordance with the manufacturer's recommendations and meets fire rating requirements.
- D. Trim:
  - 1. Use longest practical lengths, with no piece less than 2 feet long for continuous runs greater than 8 feet. Securely fasten and align trim ends at joints.
  - 2. Place concealed flange corner beads at external corners. At angles other than 90 degrees, bend the flange to conform to the angle.
  - 3. Place concealed flange type L trim where gypsum board abuts dissimilar materials.
  - 4. Use J trim at exposed gypsum board edges and at joints where sealant is indicated.
- E. Allow a 1/2 inch gap where gypsum board extends to overhead structure and deflection provisions are incorporated into lightgauge metal framing. Do not fasten gypsum board to top runner.
- F. Sealant Joints:
  - 1. Coordinate installation of firestopping and sealants at concealed joints between partitions and structure at fire rated and acoustically insulated partitions.
  - 2. Where sealant joints are indicated at ends or edges of wallboard, install for uniform 1/8 inch joint, unless otherwise indicated. Installation of sealant in exposed locations is specified in Section 07 9200.
- G. Install required number of layers of wallboard behind panel boards and other recessed elements as necessary to maintain fire rating of walls.

### 3.3 CEILING AND SOFFIT SUPPORT MATERIALS

- A. Hanger Anchorage Devices: Screws, clips, bolts or other devices compatible with indicated structural anchorage for ceiling hangers and whose suitability has been proven through standard construction practices or by certified test data.
- B. Powder-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers [and with capability to sustain, without failure, a load equal to 10x calculated loads].
- C. Hangers:
  - 1. Steel wire or rods, sizes to comply with requirements of ASTM C754 for ceiling or soffit area and loads to be supported.
  - 2. Wire: ASTM A 641, soft, Class 1 galvanized.
  - 3. Rods and flats:
    - 1. Mild steel components.
    - 2. Finish: Galvanized or painted with rust-inhibitive paint for interior work; galvanized for exterior work.

### 3.4 CONTROL JOINTS

- A. Discontinue gypsum board and use control joint trim at control joints.
- B. Coordinate with the framing installer to ensure that framing is installed immediately on either side of each control joint.
- C. Space control joints as indicated. When not indicated, locate as follows:
  - 1. At maximum 30 foot intervals along continuous wall planes.

**SECTION 092116 GYPSUM BOARD**

2. At maximum 50 foot intervals at continuous ceilings with perimeter relief.
  3. At maximum 30 foot intervals at continuous ceilings without perimeter relief.
  4. At locations where expansion or control joints occur in the building structure.
  5. Locate control joints to form rectangular or square sections, in "L," "U," "T," or other irregularly shaped areas.
  6. Position control joints to intersect light fixtures, air diffusers, door openings, and other areas of stress concentration.
  7. Coordinate with Section 092200 for special requirements at fire rated assemblies.
- D. Verify location with the Architect prior to installation. Give the Architect a minimum of 48 hours notice.

**3.5 FINISHING**

- A. Provide finishing in accordance with GA 214.
- B. Where necessary to sand, do so without damaging the face of the gypsum board.
- C. Levels of Finish:
1. Level 5: Provide at the following locations:
    - a. Surfaces perpendicular and adjacent to or near (within 24 inches of) exterior windows, and surface mounted light fixtures.
    - b. Surfaces to receive deep tone colors and/or semi-gloss or gloss finishes.
  2. Level 4: Typical, unless indicated or specified otherwise.
  3. Level 3: Provide at the following locations:
    - a. Surfaces to receive vinyl wall covering.
  4. Level 2: Provide at the following locations:
    - a. Storage rooms.
    - b. Mechanical rooms.
    - c. Janitors closets..
  5. Level 1: Provide at the following locations:
    - a. Surfaces of fire rated assemblies concealed from view in the finished work ("fire-taping").
    - b. Surfaces of acoustical assemblies concealed form view in the finished work
- D. Level 4 and 5 finishes: Return to the site after primer is applied, and touch-up surface defects.

**3.6 TOLERANCES**

- A. Install gypsum board with 1/8 inch in 10 feet maximum variation from plane in any direction.

**END OF SECTION**

**SECTION 09 3000 TILING**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Floor and wall tile finishes.
  - 2. Marble thresholds.
- B. Related Sections:
  - 1. Division 01: Administrative, procedural, and temporary work requirements.
  - 2. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
  - 1. A108/A118/A136.1 - American National Standard for Installation of Ceramic Tile.
  - 2. A137.1 - Specifications for Ceramic Tile.
- B. ASTM International (ASTM):
  - 1. A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. A185/A185M - Standard Specification for Welded Steel Wire Reinforcement, Plain, for Concrete.
  - 3. C144 - Standard Specification for Aggregate for Masonry Mortar.
  - 4. C150 - Standard Specification for Portland Cement.
  - 5. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
  - 6. C847 - Standard Specification for Metal Lath.
  - 7. C1028 - Standard Test Method for Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
  - 8. D226 - Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
  - 9. D227 - Standard Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
  - 10. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
  - 11. D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications.
- C. Tile Council of North America (TCNA) - Handbook for Ceramic Tile Installation.
- D. Resilient Floor Covering Institute (RFCI) - FloorScore Certification Program.

1.3 SUBMITTALS

- A. Submittals for Review:
  - 1. Product Data: Manufacturer's installation, cleaning, and maintenance instructions.
  - 2. Samples:
    - a. Tile: [Full size samples in each color.]
    - b. Grout: [1/2 x 1/2 x 3] inch long samples [showing available colors.]

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum [5] years [documented] experience in work of this Section.

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**SECTION 09 3000 TILING**

- B. Tile and Trim Units: Meet ANSI A137.1,.
- C. Static Coefficient of Friction for Floor Tile: Minimum 0.60, tested to ASTM C1028 in dry condition.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver mortar, adhesive, and grout containers bearing hallmark certifying compliance with reference standards.
- B. Protect adhesive containers from freezing and overheating according to manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain minimum ambient temperature of [50] degrees F during and after installation.

1.7 MAINTENANCE

- A. Extra Materials: [2] percent of each tile.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Tile:
  - 1. Marca Corona
  - 2. Daltile
  - 3. [ ].
  - 4. [ ].
- B. Acceptable Manufacturers - Setting and Grouting Materials:
  - 1. Bostik Findley. ([www.bostik-us.com](http://www.bostik-us.com))
  - 2. Laticrete International, Inc. ([www.laticrete.com](http://www.laticrete.com))
  - 3. Mapei Corp. USA. ([www.mapei.com](http://www.mapei.com))
  - 4. TEC. ([www.tecspecialty.com](http://www.tecspecialty.com))
- C. Substitutions: [Under provisions of Division 01.]

2.2 MATERIALS

- A. Tile:
  - 1. Size: [12 x 24 inches .
  - 2. Color: as specified on drawings
  - 3. Trim units: bullnoses color to match tile.

2.3 ACCESSORIES

- A. Mortar:  
Large and Heavy Tile Format, Latex Modified Cement Mortars (for the installation of tiles equal to and larger than 15" on one side)

TEC® Ultimate Large Tile Mortar, one-part, light weight latex thin set mortar conforming to ANSI A118.4 & A118.11, minimum 28 day shear strength (Porcelain) minimum 330 psi as manufactured 093000-2

by H.B. Fuller Construction Products Inc. Color: [white].

- B. Water: Clean, potable.
- C. Grout:
  - High Performance Cementitious Grout. Provide grout with less than 1.2% absorption, minimum of 10,000 psi 28 day compressive strength conforming to ANSI A118.7. This grout does not require sealing. For floors and walls for grouting joints 1/16" to 1/2" and is backed by a limited lifetime product warranty.
  - TEC® Power Grout®, stain resistant, crack resistant, zero efflorescence, polymer-modified, sanded High Performance cement grout mixed with water per manufacturer's instructions as manufactured by H.B. Fuller Construction Products Inc. [color Dove Gray]
- D. Thresholds: Class A [stone to match tile, honed finish, beveled both sides, radiused from bevels to vertical planes, one piece for full width of door or opening.
- E. Joint Sealers: Specified in Section 07 9200.
- F. Crack Suppression Membrane:
  - 1. Type: ANSI A118.12, load bearing, [single component or cold liquid applied type with reinforcing fabric.
- G. Joint Tape: Waterproof, perforated bedding tape.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Clean surfaces to remove loose and foreign matter that could impair adhesion.
- B. Remove ridges and projections. Fill voids and depressions with patching compound compatible with setting materials.
- C. Allowable Substrate Tolerances:
  - 1. Thin set method:
    - a. Maximum variation in substrate surface: [1/8] inch in 8 feet.
    - b. Maximum height of abrupt irregularities: [1/32] inch.
  - 2. Thick set method: Maximum [1/4] inch in 10 feet variation in substrate surface.
- D. Test concrete substrate to ASTM D4263; do not install tile until surfaces are sufficiently dry.
- E. Provide cementitious, trowelable, patch material to remedy any depressions in existing slab to allow for flat and level installation of tile. Product shall be TEC® VersaPatch® Latex Modified Floor Patch and Leveler as manufactured by H.B. Fuller Construction Products Inc. or equal
- F. For interior large format, floor tile installations using 15" or greater on one side tile, install self-leveling underlayment at 1/4" to insure flat, level floor installation and appropriate mortar coverage to back of tile and substrate. Prime all porous surfaces according to manufacturer's instructions. Products shall be TEC® Multipurpose Primer™, and TEC® Level Set 300® Self Leveling Underlayment as manufactured by H.B. Fuller Construction Products Inc.

#### **3.2 INSTALLATION**

- A. Install [crack suppression membrane] in accordance with manufacturer's instructions.
- B. Methods:
  - 1. Walls: ANSI A108.4, thin set with organic adhesive.
  - 2. Floors: ANSI thin set with latex-portland cement mortar.]
- C. Minimize pieces less than one half size. Locate cuts to be inconspicuous.
- D. Lay tile to pattern as shown on Drawings. Do not interrupt tile pattern through openings.

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**SECTION 09 3000 TILING**

- E. Joint Widths:
  - 1. Porcelain tile: [3/16]
- F. Make joints watertight, without voids, cracks, excess mortar, or excess grout. [Align joints in wall and floor of same-sized tile.]
- G. Fit tile around projections and at perimeter. Smooth and clean cut edges. Ensure that trim will completely cover cut edges.
- H. Install Trim:
  - 1. Inside corners: Cove units.
  - 2. Outside corners: Bead units.
  - 3. Base: Base units.
  - 4. Exposed tile ends: Bullnose units.
- I. Install thresholds where tile abuts dissimilar floor finish. Center on door or opening.
- J. Allow tile to set for a minimum of [48] hours before grouting.
- K. Grout tile joints in accordance with ANSI A108.10 without excess grout.
- L. Control Joints:
  - 1. Provide control joints at:
    - a. Changes in backup material.
    - b. Changes in plane.
    - c. Over joints in substrate.
    - d. Maximum [32] feet on center at interior locations except maximum [12] feet at surfaces exposed to direct sunlight.
    - e. Maximum [16] feet on center at exterior locations.
  - 2. Form joints per TCNA Method EJ-171.
  - 3. Install joint backing and joint sealer as specified in Section 07 9200.

3.3 ADJUSTING

- A. Remove and replace pieces that have been damaged during installation.

3.4 PROTECTION

- A. Provide protection for completed work using nonstaining sheet coverings.
- B. Prohibit traffic on tile floors for minimum [3] days after installation.

END OF SECTION

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**SECTION 09 5000 ACOUSTICAL CEILING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

**1.2 SUMMARY**

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Sections

1. Section 09 51 00 - Acoustical Ceilings
2. Section 09 51 13 - Acoustical Fabric-Faced Panel Ceilings
3. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
4. Section 09 20 00 - Plaster and Gypsum Board
5. Section 01 81 13 - Sustainable Design Requirements
6. Section 01 81 19 - Indoor Air Quality Requirements
7. Section 02 42 00 - Removal and Salvage of Construction Materials
8. Divisions 23 - HVAC Air Distribution
9. Division 26 - Electrical

C. Alternates

1. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

**1.3 REFERENCES**

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

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**SECTION 09 5000 ACOUSTICAL CEILING**

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material
  - A. Armstrong Fire Guard Products
10. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
11. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
12. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
13. ASTM E 1264 Classification for Acoustical Ceiling Products
  - B. International Building Code
  - C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality
  - D. NFPA 70 National Electrical Code
  - E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
  - F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
  - G. International Code Council-Evaluation Services Report - Seismic Engineer Report
    1. ESR 1308 - Armstrong Suspension Systems
  - H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
    1. 0244 - Armstrong Single Span Suspension System
  - I. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010
  - J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings
  - K. International Well Building Standard
  - L. Mindful Materials
  - M. Living Building Challenge
  - N. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

**SECTION 09 5000 ACOUSTICAL CEILING**

**1.4 SYSTEM DESCRIPTION**

Continuous/Wall-to-Wall

**1.5 SUBMITTALS**

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

a. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

**1.6 SUSTAINABLE MATERIALS**

Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

1. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.

2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).

3. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1 (Section 01350).

4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.

**SECTION 09 5000 ACOUSTICAL CEILING**

5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.

**1.7 QUALITY ASSURANCE**

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

**1.8 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, and 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 damaged units in any way.

**1.9 PROJECT CONDITIONS**

A. Space Enclosure:

Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

**SECTION 09 5000 ACOUSTICAL CEILING**

HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

HumiGuard Max Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Ceilings with HumiGuard Max performance can be installed in conditions up to 120°F (49°C) and maximum humidity exposure including outdoor applications, and other standing water applications, so long as they are installed with either SS Prelude Plus, AL Prelude Plus, or Prelude Plus Fire Guard XL suspension systems. Products with Humiguard Max performance can be installed in exterior applications, where standing water is present, or where moisture will come in direct contact with the ceiling. Only Ceramaguard with AL Prelude Plus suspension system can be installed over swimming pools.

**1.10 ALTERNATE CONSTRUCTION WASTE DISPOSAL**

A. Ceiling material being reclaimed must be kept dry and free from debris.

B. Contact the Armstrong Recycle Center a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycling of the ceiling.

**1.11 WARRANTY**

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion
2. Suspension: Ten (10) years from date of substantial completion
3. Ceiling System: Thirty (30) years from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

**1.12 MAINTENANCE**

**SECTION 09 5000 ACOUSTICAL CEILING**

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Ceiling Panels:

1. Armstrong World Industries, Inc.

B. Suspension Systems:

1. Armstrong World Industries, Inc.

C: Perimeter Systems

1. Armstrong World Industries, Inc.

**2.2.1 ACOUSTICAL CEILING UNITS**

A. Acoustical Panels Type AP

1. Surface Texture: Fine
2. Composition: Mineral Fiber
3. Color: White
4. Size: 24 in x 48 in
5. Edge Profile: Beveled Tegular 15/16 in for interface with PRELUDE XL 15/16" Exposed Tee grid.
6. Noise Reduction Coefficient( NRC): ASTM C 423; Classified with UL label on product carton 0.75
7. Ceiling Attenuation Class (CAC) : ASTM C 1414; Classified with UL label on product carton 35
8. Sabin:N/A
9. Articulation Class (AC):
10. Flame Spread: ASTM E 1264; Class A (UL)
11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.90
12. Dimensional Stability: HumiGuard Plus
13. Recycle Content: Post-Consumer - 0% - 1% Pre-Consumer - 75% - 76%
14. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
15. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)

**SECTION 09 5000 ACOUSTICAL CEILING**

16. Acceptable Product: ULTIMA Lay-In and Tegular, 1914 No added formaldehyde as manufactured by Armstrong World Industries

**2.3.1 METAL SUSPENSION SYSTEMS**

A. Components:

Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

- a. Structural Classification: ASTM C 635 Intermediate Duty
- b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
- c. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)

d. Acceptable Product: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:

- 1. 7800 - 12' Wall Molding

E. Accessories:

- 1. 7445 - Stabilizer Bar

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

**3.2 PREPARATION**



**SECTION 09 5000 ACOUSTICAL CEILING**

A. 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. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

**3.3 INSTALLATION**

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4'-0" on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

**3.4 ADJUSTING AND CLEANING**

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycle of the ceiling.

**End of section**

**SECTION 096519 RESILIENT TILE FLOORING**

Part 1 - General

**1.01 Summary**

- A. Section Includes:
  - 1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.
- B. Related Documents
  - 1. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.
- C. Related Sections:
  - 1. Other Division 9 sections for floor finishes related to this section but not the work of this section

**1.02 References**

- A. ASTM International:
  - 1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
  - 2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
  - 3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
  - 4. ASTM F 1066 Standard Specification for Vinyl Composition Tile
  - 5. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
  - 6. ASTM F 1861 Standard Specification for Resilient Wall Base
  - 7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  - 8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- C. National Fire Protection Association (NFPA):
  - 1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
  - 2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials
- D. Sustainability Standards
  - 1. ASTM E1347 - 06(2011) Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry
  - 2. ASTM D5116 - 10 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products and California Department of Public Health (CDPH) Standard Method V1.1-2010
  - 3. ASTM D6866 - 12 Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis.
  - 4. ISO 14001 Environmental management systems -- Requirements with guidance for use
  - 5. ISO 14021 Environmental labels and declarations-Self-declared environmental claims (Type II environmental labeling)

## SECTION 096519 RESILIENT TILE FLOORING

6. ISO 14024 Environmental labels and declarations -- Type I environmental labeling -- Principles and procedures
7. ISO 14025 Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures
8. NSF/ANSI 332: Sustainability Assessment for Resilient Floor Coverings

### 1.03 System Description

- A. Performance Requirements:  
Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- B. Administrative Requirements
  1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
  2. Pre-installation Testing: Conduct pre-installation testing as follows: i.e. moisture tests, bond test, pH test, etc)
- D. Sequencing and Scheduling
  1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
  2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

### 1.04 SUBMITTALS

- A. Tech Data - Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Samples - Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. MSDS - Submit Material Safety Data Sheets (MSDS) available for flooring products, adhesives, patching/leveling compounds, floor finishes (polishes) and cleaning agents.
- D. Closeout Submittals: Submit the following:
  - a. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
  - b. Warranty: Warranty documents specified herein

### 1.05 QUALITY ASSURANCE

- A. Responsibility

## SECTION 096519 RESILIENT TILE FLOORING

Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.

- B. Fire Performance Characteristics: Provide resilient vinyl composition tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
  - a. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
  - b. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Deliverability  
Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Storage  
Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

### 1.07 PROJECT CONDITIONS

- A. Temperature  
Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of [100°F (38°C)][85°F (29°C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to the Armstrong Guaranteed Installations Systems manual, F-5061 for a complete guide on project conditions.

### 1.08 WARRANTY

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Warranty Period  
Warranty Period: 5 years
- C. Rights  
The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

**SECTION 096519 RESILIENT TILE FLOORING**

D. Validation

For the Warranty to be valid, this product is required to be installed using the appropriate Armstrong Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

**Part 2- PRODUCTS**

**2.01 Manufacturer**

A. Resilient tile flooring, wall base, adhesives and accessories:

1. Armstrong World Industries, Inc.,
2. Mannington Commercial
3. Tarkett
4. Approved Equal

**2.02 Resilient Tile Flooring Materials**

A. Products – Basis of Design

Provide Vinyl Composition Tile: Match existing color and style.

- a. Description: Tile composed of polyvinyl chloride resin, plasticizers, fillers, stabilizers and pigments with colors and texture dispersed uniformly throughout its entire thickness.
- b. Vinyl composition tile shall conform to the requirements of ASTM F 1066, 'Standard Specification Vinyl Composition Floor Tile', Class 2, through-pattern
- c. Color to be submitted for approval with chip of existing - 12 x 12 x 1/8

**2.03 Wall Base Materials**

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set - Style B, Cove.

- a. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
- b. Height: 4 inch (100 mm).
- c. Thickness: 0.125 inch (3.2 mm)thick.
- d. Finish: Satin.
- e. Length: Roll.
- f. Color: As scheduled on drawings.

B. Manufacturers:

- a. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
- b. Roppe Corp: [www.roppe.com](http://www.roppe.com).
- c. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com)
- d. Approved Equal

**2.05 Adhesives**

A. Full Spread

For Tile Installation System, Full Spread: Provide Armstrong S-750 Premium Tile Flooring Adhesive under the tile and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

## SECTION 096519 RESILIENT TILE FLOORING

### B. Tile On

[For Tile Installation System, Tile On: Provide Armstrong S-750 Premium Tile Flooring Adhesive Resilient Tile Adhesive under the tile over smooth, completely bonded existing resilient flooring and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

### C. High Moisture

For Tile High-Moisture Installation Warranty, Full Spread: Provide Armstrong S-515 Clear Thin Spread Tile Adhesive Resilient Tile Adhesive under the tile and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

## 2.06 Accessories

### A. Patching

For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Armstrong S-184 Fast-Setting Cement-Based Patch and Underlayment

### B. Sealing

For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.

### C. Transition

Provide transition/reducing strips tapered to meet abutting materials.

### D. Threshold

Provide threshold of thickness and width as shown on the drawings.

### E. Resilient Edge Strips

Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.

### F. Metal Edge Strips

Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

## Part 3 - EXECUTION

### 3.01 Manufacturer's Instructions

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

### 3.02 Examination

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**A. Site Verification**

Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).

**B. Visual Inspection**

Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.

**C. Examine Subfloors**

Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.

**D. Inspect Subfloors**

Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.

**E. Reporting**

Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

**F. Failure Warning**

Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

**3.03 Preparation**

**A. Smooth Surfaces**

Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong S-184 Fast-Setting Cement-Based Patch and Underlayment as recommended by the flooring manufacturer. Refer to Armstrong Guaranteed Installation Systems manual, F-5061 and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

**B. Subfloor Cleaning**

Subfloor Cleaning: Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Refer to the Armstrong Guaranteed Installation Systems manual, F-5061 and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

**C. Full Spread / Tile Installation**

For Tile Installation System, Full Spread or for Tile Installation System, Tile On , perform subfloor moisture testing in accordance with [ASTM F 2170, 'Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes'] [ASTM F

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1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride] and Bond Tests as described in the Armstrong Guaranteed Installation Systems manual, F-5061, to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. [Relative humidity shall not exceed 80%.][MVER shall not exceed 5 lbs./1000 sq. ft./24 hrs.] On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained]

### D. High Moisture S-515

For Tile High-Moisture Installation Warranty when using S-515 Adhesive, perform subfloor moisture testing in accordance with [ASTM F 2170, 'Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes'] [ASTM F 1869, 'Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride' and Bond Tests as described in the Armstrong Guaranteed Installation Systems manual, F-5061, to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. [Relative humidity shall not exceed 90%.][MVER shall not exceed 7 lbs./1000 sq. ft./24 hrs.] On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained].

### G. PH Test

Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

### I. Surface Cleaning

Surface Cleaning: Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

## 3.04 Installation of Flooring

### A. Wall to Wall

Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

### D. Scribe

Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

### E. Tools

Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

## 3.05 Installation of Accessories

### A. Top Set



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Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

**B. Voids**

Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.

**C. Resilient Edge Strips**

Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

**3.06 Cleaning**

**A. Initial Maintenance**

Perform initial and on-going maintenance according to the latest edition of Manufacturer Installation Systems manual.

**3.07 Protection**

**A. Protection**

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 096813 TILE CARPETING**

**GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Tile carpeting.
  - 2. [Edgings] [Cap strips].
- B. Related Sections:
  - 1. Division 01: Administrative, procedural, and temporary work requirements.
- C. Allowances:
  - 1. Include a unit cost allowance of \$[ ] per square foot for carpet tiles.  
Installation is [included in amount of allowance.]

1.2 REFERENCES

- A. ASTM International (ASTM):
  - 1. D2859 - Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
  - 2. D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
  - 3. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 4. E648 - Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
  - 5. E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
  - 6. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- B. Carpet and Rug Institute (CRI):
  - 1. 104 - Standard for Installation Specification of Commercial Carpet.
  - 2. Indoor Air Quality Testing Program.
- C. National Fire Protection Association (NFPA) 253 - Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Submittals for Review:
  - 1. Shop Drawings: Indicate carpet tile locations, dye lot limitations, direction of carpet tile in each room or area, and type and location of edgings.
  - 2. Samples:
    - a. Carpet tile: [[12 x 12] inch samples showing available colors.] [Full size samples in each color and pattern.]
    - b. [Edgings:] [Cap strips:] [4] inch long samples showing color.
  - 3. Warranty: Sample warranty form.
- B. Quality Control Submittals:
  - 1. Certificates of Compliance: Certification from an independent testing laboratory that carpet tiles meet fire hazard classification requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum [5] years [documented] experience in work of this Section.

**SECTION 096813 TILE CARPETING**

- B. Fire Hazard Classification: Maximum flame spread/smoke developed rating of [75/125] , tested to ASTM E84.

1.5 PROJECT CONDITIONS

- A. Do not begin installation until painting and finishing work have been completed.
- B. Environmental Requirements:
  - 1. Temperature of spaces and subfloor between [65 and 90] degrees F.
  - 2. Humidity in spaces to receive carpet tiles between [20 and 65] percent.

1.6 WARRANTIES

- A. Furnish [manufacturer's and applicator's] warranty providing coverage against defective materials and workmanship.

1.7 MAINTENANCE

- A. Extra Materials: [2] percent] of each color and pattern.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Interface, Inc. ([www.interfaceinc.com](http://www.interfaceinc.com))
- B. Substitutions: [Not permitted.]

2.2 MATERIALS

- A. Carpet Tiles:
  - 1. Source: Interface
  - 2. Pattern: Cubic
  - 3. Color: height

2.3 ACCESSORIES

- A. Adhesive:
  - 1. Waterproof, latex based cement formulated specifically for installing carpet tiles; recommended by carpet tile manufacturer.
- B. Edgings: Preformed [rubber,] or approved substitute, profile required to suit conditions, color [to be selected from manufacturer's full color range.] [to match carpet tiles.]
- C. Cap Strip: Preformed [rubber;] [, prefinished metal;] profile required to suit conditions, color [to be selected from manufacturer's full color range.] [to match carpet tiles.]
- D. Leveling Compound: Premixed, [latex] based.

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that concrete floors have cured a minimum 28 days and do not exhibit negative alkalinity, carbonization, or dusting.

### 3.2 PREPARATION

- A. Clean substrate to ASTM D4258.
- B. Clean substrate; remove loose and foreign matter that could impede adhesion or performance of flooring.
- C. Fill cracks, voids, and depressions with leveling compound.
- D. Grind ridges and high spots smooth.
- E. Test substrate for moisture content to ASTM F1869; do not install carpet tiles until moisture emission level is acceptable to carpet tile manufacturer.

### 3.3 INSTALLATION OF CARPET TILES

- A. Install in accordance with CRI 104.
- B. Install carpet tile [and adhesive] in accordance with manufacturers' instructions.
- C. Blend carpet tiles from different cartons to ensure minimal variation in color match.
- D. Lay out each room or area to minimize tiles less than one half size.
- E. Cut tile clean. Fit tiles tight to intersection with vertical surfaces without gaps.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tiles to substrate.

### 3.4 INSTALLATION OF EDGINGS

- A. Install strips where carpet tiles abut dissimilar flooring materials; secure to subfloor.
- B. Center strips under doors where carpet tiles terminate at door openings.
- C. Install in longest practical lengths; butt ends tight.
- D. Scribe to abutting surfaces.

### 3.5 CLEANING

- A. Clean spots as recommended by carpet tile manufacturer.
- B. Cut off loose threads flush with top surface.
- C. Clean with commercial vacuum cleaner.

END OF SECTION

**SECTION 09 9000 INTERIOR PAINTS AND COATINGS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Floors, unless specifically so indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

**1.2 RELATED SECTIONS**

- A. 055000 – Metal Fabrications: Shop-primed items.

**1.3 REFERENCES**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2003.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 2003).
- D. GreenSeal GS-11 - Paints; 1993.
- E. NACE (IMP) - Industrial Maintenance Painting; NACE International; Edition date unknown.
- F. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- a. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1) Paint: [1 gal. (3.8 L)] of each material and color applied.

**1.5 SUBMITTALS**

- A. Submit under provisions of Article 4.7 of General Conditions.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit two samples, 12x12 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.

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**SECTION 09 9000 INTERIOR PAINTS AND COATINGS**

- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

**1.6 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

**1.8 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints: (see finish schedule for Products)
  - 1. Sherwin Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com) for Exterior painting.
  - 2. PPG Architectural Finishes, Inc: [www.ppgaf.com](http://www.ppgaf.com) for Exterior painting.
  - 3. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com). for Interior painting.
  - 4. Approved Equal

**2.2 PAINTS AND COATINGS - GENERAL**

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

**SECTION 09 9000 INTERIOR PAINTS AND COATINGS**

- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Architectural coatings VOC limits of State in which the project is located.
    - c. USGBC LEED Rating System, edition as stated in Section 01355; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

**2.3 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
  - 1) Report, in writing, conditions that may affect application, appearance, or performance of paint.
- E. Substrate Conditions:
  - 1) Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a) Concrete: 12 percent.
    - b) Masonry (Clay and CMU): 12 percent.
    - c) Wood: 15 percent.
    - d) Gypsum Board: 12 percent.
    - e) Plaster: 12 percent.
  - 2) Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
  - 3) Plaster Substrates: Verify that plaster is fully cured.
  - 4) Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

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**SECTION 09 9000 INTERIOR PAINTS AND COATINGS**

**3.2 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- L. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- M. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1) Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- N. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  - 1) Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- O. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- P. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.] [ **but not less than the following:**]
  - 1) SSPC-SP 2, "Hand Tool Cleaning."

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- 2) SSPC-SP 3, "Power Tool Cleaning."
- 3) SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

**3.3 APPLICATION**

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1) Use applicators and techniques suited for paint and substrate indicated.
  - 2) Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3) Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4) Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5) Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
  - b. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
  - c. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
  - d. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
  - e. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
    - 1) Paint the following work where exposed in equipment rooms:
      - a) Equipment, including panelboards[ **and switch gear**].
      - b) Uninsulated metal piping.
      - c) Uninsulated plastic piping.
      - d) Pipe hangers and supports.
      - e) Metal conduit.
      - f) Plastic conduit.
      - g) Tanks that do not have factory-applied final finishes.

**SECTION 09 9000 INTERIOR PAINTS AND COATINGS**

- h) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
- 2) Paint the following work where exposed in occupied spaces:
  - a) Equipment, including panelboards.
  - b) Uninsulated metal piping.
  - c) Uninsulated plastic piping.
  - d) Pipe hangers and supports.
  - e) Metal conduit.
  - f) Plastic conduit.
  - g) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - h) Other items as directed by Architect.
- 3) Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

**A. INTERIOR PAINTING SCHEDULE CMU Substrates:**

1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior:
  - 1) S-W PrepRite Block Filler, B25W25, at **75-125 sq. ft. per gal.** (**1.84 to 3.07 sq. m per liter**).
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, eggshell:
  - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at **4.0 mils (0.102 mm)** wet, **1.7 mils (0.043 mm)** dry, per coat.
- d. Topcoat: Latex, interior, semi-gloss:
  - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at **4.0 mils (0.102 mm)** wet, **1.6 mils (0.041 mm)** dry, per coat.

**B. Metal Substrates (Aluminum, Steel, Galvanized Steel):**

1. Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based:
  - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at **5.0 to 10 mils (0.127 to 0.254 mm)** wet, **2.0 to 4.0 mils (0.051 to 0.102 mm)** dry.
- b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
- c. Topcoat: Water-based acrylic, semi-gloss:
  - 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at **2.5 to 4.0 mils (0.064 to 0.102 mm)** dry, per coat.
- d. Topcoat: Water-based acrylic, gloss:  
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- 1) S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.

C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior:

- 1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, eggshell:

- 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.

d. Topcoat: Latex, interior, semi-gloss:

- 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

e. Topcoat: Latex, interior, gloss:

- 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

D. [Gypsum Board] [Plaster] [and] [Spray-Texture Ceiling] Substrates:

1. Latex System:

a. Prime Coat: Primer, latex, interior:

- 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat:

- 1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

d. Topcoat: Latex, interior, low sheen:

- 1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

e. Topcoat: Latex, interior, eggshell:

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- 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
- f. Topcoat: Latex, interior, semi-gloss:
- 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
- g. Topcoat: Latex, interior, gloss:
- 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

### 3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Finish equipment, piping, conduit, and exposed duct work.
- C. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.5 CLEANING

- i. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- ii. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- iii. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- iv. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- v. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
  1. Items fully factory-finished unless specifically noted.
  2. Fire rating labels, equipment serial number and capacity labels.
  3. Stainless steel items.
- B. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
  1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
  2. Paint shop-primed items occurring in finished areas.
  3. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

**END OF SECTION**

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**SECTION 102800 WASHROOM ACCESSORIES**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Washroom accessories as scheduled in this Section and as indicated on the Drawings.

1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry, coordination with blocking.

1.3 SUBMITTALS

- A. Submit under provisions of General Conditions Article 4.7.
- B. Product Data: Submit manufacturer's data sheets for each product specified, including the following:
  - 1. Installation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Cleaning and maintenance instructions.
  - 4. Replacement parts information.
- C. Schedule: Submit a toilet accessory schedule, indicating the type and quantity to be installed in each washroom. Use room numbers as indicated on the Drawings.

1.4 QUALITY ASSURANCE

- A. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.
- B. Hazardous Materials: Comply with EU Directive "Restrictions of Hazardous Substances (RoHS) requirements."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.6 WARRANTY

- A. Manufacturer's Warranty for Washroom Accessories: Manufacturer's standard 1 year warranty for materials and workmanship.

**SECTION 102800 WASHROOM ACCESSORIES**

**PART 2 PRODUCTS**

2.1 MANUFACTURER

- A. Manufacturers:
  - 1) Bradley
  - 2) Bradley Corporation
  - 3) Inpro
  - 4) Georgia Pacific
  - 5) Approved equal
  
- B. Accessory schedule: See toilet plan drawing for schedule

**PART 3 EXECUTION**

3.1 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
  - 1. Verify blocking has been installed properly.
  - 2. Verify location does not interfere with door swings or use of fixtures.
  - 3. Comply with manufacturer's recommendations for backing and proper support.
  - 4. Use fasteners and anchors suitable for substrate and project conditions
  - 5. Install units rigid, straight, plumb, and level, in accordance with manufacturer's installation instructions and approved shop drawings.
  - 6. Conceal evidence of drilling, cutting, and fitting to room finish.
  - 7. Test for proper operation.

3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces of compartments, hardware, and fittings using methods acceptable to the manufacturer.
  
- B. Touch-up, repair or replace damaged products until Substantial Completion.

END OF SECTION

## FIRE EXTINGUISHERS

### 1.1 SECTION INCLUDES

- A. Fire extinguishers.

### 1.2 REFERENCES

- A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2007.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

### 1.3 SUBMITTALS

- A. See General Conditions Article 4.7 for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Fire Extinguishers and Accessories:
  - 1. JL Industries, Inc; Product Panorama 1035C70: [www.jlindustries.com](http://www.jlindustries.com).
  - 2. Larsen's Manufacturing Co; Product Gemini GSS2409R2-C: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Apex
  - 4. Approved Equal

### 2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
  - 1. Provide extinguishers labeled by Underwriters Laboratories Inc. for the purpose specified and indicated. Verify that extinguishers will meet Green requirements and do not contain CFC's or HCFC's.
- B. Dry Chemical Type Fire Extinguishers: Heavy duty steel tank, with pressure gage.
  - 1. Class A:B:C.
  - 2. Size 10.
  - 3. Rating: 4-A: 60B:C
  - 4. Model: Cosmic 10E by J.L. Industries, Inc. or MP10 by Larsen's Manufacturing Co.

## PART 3 EXECUTION

### 2.3 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### 2.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.

**END OF SECTION**

104415-1

**SECTION 11 52 13.52**  
ACCESS E FREE-HANGING CEILING-RECESSED FRONT PROJECTION SCREENS

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrically operated, ceiling recessed, front projection screens.

**1.2 RELATED SECTIONS**

- A. Division 5 - Metal Fabrications: Suspension systems for projection screens.
- B. Section 06 40 00 - Architectural Woodwork.
- C. Section 09 22 26 - Suspension Systems.
- D. Section 09 26 13 - Gypsum Veneer Plastering.
- E. Section 09 21 16.23 - Gypsum Board Shaft Wall Assemblies.
- F. Section 09 51 23 - Acoustical Tile Ceilings.
- G. Division 26 for electrical wiring, connections, and installation of remote control switches for electrically operated projection screens.

**1.3 REFERENCES**

- A. NFPA 70 - National Electrical Code.
- B. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.
- C. GREENGUARD Environmental Institute Gold.
- D. US Green Building Council.

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Wiring diagram for electrically operated units.
- D. Shop Drawings: Shop drawings showing layout and types of projection screens. Show the following:
  - 1. Location of screen centerline.
  - 2. Location of wiring connections.
  - 3. Seams in viewing surfaces.
  - 4. Detailed drawings for concealed mounting.
  - 5. Connections to suspension systems.
  - 6. Anchorage details.
  - 7. Accessories.



**SECTION 11 52 13.52**

**ACCESS E FREE-HANGING CEILING-RECESSED FRONT PROJECTION SCREENS**

8. Frame details.

- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.
- B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver projection screens until building is enclosed and other construction where screens will be installed is substantially complete.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Protect screens from damage during delivery, handling, storage, and installation.

1.7 COORDINATION

- A. Coordinate work with installation of ceilings, walls, electric service power characteristics, and location.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Draper Inc, which is located at: 411 S. Pearl, P. O. Box 425; Spiceland, IN 47385-0425; Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Email:[request info \(drapercontract@draperinc.com\)](mailto:request info (drapercontract@draperinc.com)); Web:[www.draperinc.com](http://www.draperinc.com)
- B. Substitutions: or approved equal
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MOTORIZED, CEILING RECESSED, FRONT PROJECTION SCREENS

- A. Access E: Electric motor operated, steel case. Ceiling-recessed, 18-gauge steel headbox, 6-1/2 inches (182 mm) deep and 6-13/16 inches (182 mm) wide with white paint finish and stamped 13-gauge steel end caps. UL approved "Suitable for use in environmental air space." Bottom closure panel forms slot for passage of viewing surface and can be released to hang down or be removed for access to operating mechanism and viewing surface. Bottom perimeter flange provides support and trim for acoustical ceiling panels and trim for gypsum board ceiling. The Access case may be ordered in advance and the screen installed later to eliminate field damage. The screen installs in minutes. Housing is symmetrical

**SECTION 11 52 13.52**

**ACCESS E FREE-HANGING CEILING-RECESSED FRONT PROJECTION SCREENS**

allowing for left and right hand motor locations and for viewing surface to unroll off front or back of roller. Steel mounting brackets slide in extruded aluminum mounting system along top of case. Brackets supporting roller/fabric assembly slide in tracks inside the top of the case, allowing viewing surface to be centered in case. Steel leveling brackets are attached to case to prevent deflection. Housing designed with internal junction box and plug-in wiring connections to allow housing to be installed and connected to building power supply separately from motor and viewing surface.

1. Motor mounted inside screen roller on rubber isolation insulators. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
2. Quiet Motor mounted inside screen roller on rubber isolation insulators. Motor operates at 44db. UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
3. Motor Screen Controls, UL certified.
  - a. Single station control rated 115V AC, 60 Hz with 3-position rocker switch with cover plate to stop or reverse screen at any point.
  - b. Multiple station control rated 115V AC, 60 Hz with 3-position rocker switches with cover plates to stop or reverse screen at any point. Automatic override allows only one signal to reach the motor when operated simultaneously
  - c. Low voltage control unit with three button 24V switches and cover plate to stop or reverse screen at any point, built-in RF receiver, built-in Video Interface Control trigger for 3V-28V, RS232, and dry contact relays.
  - d. Low voltage 24V control unit with hand held RF remote three button control switch to stop or reverse screen at any point, built-in RF receiver, built-in Video Interface Control trigger for 3V-28V, RS232, and dry contact relays.
  - e. Low voltage 24V control unit with hand held IR remote three button control switch to stop or reverse screen at any point, built-in RF receiver, built-in Video Interface Control trigger for 3V-28V, RS232, and dry contact relays.
  - f. Key Operated power supply switch to control power to control system.
  - g. Locking switch cover plate for limited access to three position switch.
  - h. Key operated 3-position control switch rated 115V AC, 60 Hz to stop or reverse screen at any point.
  - i. 3-position low voltage control switch with key locking cover plate rated 24V to stop or reverse screen at any point.
  - j. Motor shall be right mounted.
  - k. Motor shall be left mounted.
4. Projection Viewing Surface:
  - a. Matt White XT1000E - On Axis gain of 1.0. 180 degree viewing cone. Washable surface. GREENGUARD Gold certified.
5. Viewing Area H x W.
  - a. 16:10 Format. Black masking borders standard.
    - 1) 165 inch (4191 mm) diagonal, 87-1/2 inches x 140 inches (2223 mm by 3556 mm).
6. Provide an extra screen drop with an overall screen drop with top border matching the viewing surface.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.

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**ACCESS E FREE-HANGING CEILING-RECESSED FRONT PROJECTION SCREENS**

- B. Verify rough-in openings are properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

**3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.
- C. Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

**3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 130800 – EXTERIOR NOISE BARRIER / ABSORBER**

Echo Barrier CS and CS Compact

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Exterior noise barrier/absorber enclosure.
- B. Related Sections:
  - 1. Division 1 Section “Temporary Facilities and Controls” for installation of exterior noise barrier/absorber - stand alone potable enclosure.

1.2 SUBMITTALS

- A. Product Data: For each type of noise barrier/absorber material, and mounting indicated.

1.3 DEFINITIONS

- A. Noise Reduction Coefficient (NRC): A single number index used to rate materials for their effectiveness in absorbing sound per ASTM C423 Standard Method of Test.
- B. Sound Transmission Coefficient (STC) : A single number index used to rate a partition's resistance to airborne sound transfer at the frequencies between 125 - 5000 Hz, as per ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements, ASTM E413 Classification for Rating Sound Insulation.
- C. Sound Transmission Loss (TL): The reduction of sound pressure at the frequencies between 125 - 4000 Hz, as per ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide baffle units and installation components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical components with appropriate markings of applicable testing and inspecting organization.
  - 1. Surface Burning Characteristics: As follows for Class A, tested per ASTM E 84.
    - a. Flame Spread: 0 - 25.
    - b. Smoke Developed: 0 - 450.

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### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver noise barrier/absorber to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Handle noise barrier/absorber carefully to avoid scratching or damaging units in any way.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Exterior Noise Barrier Cutting Enclosure:
  - 1. Echo Barrier CS cutting station or CS Compact by Echo Barrier USA, LLC (Basis of Design)
    - a. 150 North Michigan Avenue, Suite 2800, Chicago, Illinois 60601
    - b. 1-603-930-3366
    - c. Toll Free: 1-800-728-9098
  - 2. Or equal.

### 2.2 Exterior Portable Cutting Enclosure Barrier System

- A. Acoustic Fill:
  - 1. Foam, non-corrosive, resistant to attack by fungus, vermin proof and non-hygroscopic.
  - 2. Free draining, self-supporting and shall retain physical and sound absorptive characteristics after long term exposure to the elements.
  - 3. Class A Fire Rating with a Flame Spread not greater than 25.
- B. Size: : CS: Height: 6ft 11in, width: 7ft 10in, Length: 10ft 8in  
CS Compact: Height: 6ft 11in, width: 7ft 10in, Length: 7ft 10in
- C. Weight: CS: 260 lbs. + 40 lbs (wheels), CS Compact: 211 lbs + 26 lbs (wheels)
- D. Weatherproof: Water resistant to IPX6 and IPX9 BS EN 60529:1992.
  - 1. **IPX6 – Protected Against Powerful Water Jets**; After testing, the barrier was dried externally before being opened for internal inspection. Slight water ingress was noted along edges of perimeter stitching and inner absorbent material. The amount found was not deemed sufficient to impair operation.
  - 2. **IPX9 – High Pressure and Temperature Water Jets**; After testing, the specimen was dried externally before being cut open for internal inspection. No water ingress was found
- E. Accessories: Not required
- F. Installation: Quick and simple requiring two persons in 15 minutes
- G. Foldable: Yes
- H. Tensile Test (ISO 17025): 5.85 kN vertical, 1.10kN horizontal
- I. Cold resistant: minus 40 degrees - The specimen completed testing in according with

specification BS EN 60068-2-1:2007 test Ab , with no visible signs of external damage or degradation

- J. Debris and Dust resistance – Debris and Dust resistant to IP4X and IP5X requirements BS 6052:1992
  - 1. **IP4X - Protected Against Access to Hazardous Parts and Against Solid Foreign Objects ;** The barrier was found to have no openings that could be penetrated by the access probe of 3/64” diameter reducing adequate clearance between the access probe and hazardous parts.
  - 2. **IP5X - Protected Against Access to Solid Foreign Objects – Dust Protected;** After testing, the barrier was cleaned externally before being cut open for internal inspection. No dust ingress was found in the absorber material.
- K. UV resistant: 3 years
- L. Night-time reflective strips: Yes
- M. Non-hazardous materials: Yes
- N. Reusable: Yes
- O. Portable: Yes
- P. Recyclable materials: Yes
- Q. Security: Unique RFID number in each acoustic component, anti-theft security cable
- R. Integrated air extraction hood : Yes
- S. Clear vinyl door way : Yes
- T. Aluminum frame mounted on locking casters : Yes
- U. Wheels : Yes (lockable)
- V. Viewing window : Yes
- W. Safety: All warning and hazard labels clearly printed on barrier at eye level
- X. Manufacturer’s Warranty: 12-month frame warranty, 24-month barrier warranty - The PVC front outer layer will come with a separate 36-month UV resistant manufacturer’s warranty.
- Y. Manuals: Complete installation and operation manuals shall accompany each unit via a QR code printed on the front outer layer of the side barrier component
- Z. Maintenance: The enclosure shall not require any special cleaning products and shall be easily cleaned with a high-pressure water spray (up to 80-100psi). A cleaning solution can be used for graffiti removal
- AA. Heavy duty, rust resistant brass metallic grommets with 1-inch diameter opening (CUI 64% ZN 36%)
- BB. Thread – a heat-resistant, non-melting, self-extinguishing sewing thread, made from continuous filament meta-aramide of the brand DuPont™ NOMEX (or similar) for high temperatures- The long-term heat resistance is approximately 428°F and decomposition temperature is approximately 698°F
- CC. Applications: Construction & demolition projects; rail and road construction/maintenance;

utility works/maintenance; site refurbishments/renovations, general building maintenance; paving works, timber/steel cutting, generator and compressor enclosure, enclosure for pumps and other noisy activities or equipment.

2.3 ACOUSTICAL PERFORMANCE

A. Sound Absorption Coefficients per ASTM C423: (All directions)

1/1 Octave Band Center Frequency (Hz)	125	250	500	1K	2K	4K	8K	NRC
Echo Barrier Panel H9 single layer	0.13	0.5	0.86	0.33	0.2	0.12	-	0.45

B. Sound Transmission Loss (dB) per ASTM E90 & Sound Transmission Class (STC): (All directions)

1/1 Octave Band Center Frequency (Hz)	Sound Transmission Loss ( TL )							STC
	125	250	500	1K	2K	4K	8K	
Echo Barrier Panel H9 single layer	8.7	9.9	9.1	19.7	30.3	36.9	-	16
Echo Barrier Panel H9 double layer	11.7	12.9	12.1	22.7	33.3	39.9	-	19

2.4 FIRE AND SMOKE PERFORMANCE

“Test for Surface Burning Characteristics of Building Materials”, (ASTM E84)

A. Table 1: Flame Spread Summary - Echo Barrier H9 components (Sides only)

Test No.	Test Code	Sample Description	CFS Calculated Flame Spread Ceiling	FSI Flame Spread Index (Ceiling)+	CFS Calculated Flame Spread (Floor)	FSI Flame Spread Index (Floor) ++
1	02151811	H9 Back side	7.42	5	157.96	160
2	02151807	H9 Front side	14.90	15	142.77	145

+ Flame Spread Index while material remained in the original test position.

++ Ignition of molted residue on the furnace floor resulted in flame travel equivalent to calculated Flame Spread Index

**Note: CS Cutting Station and CS Compact Cutting roof component, vinyl doors and windows - Fire Performance: Class B1 = German DIN 4102 B1**

B. Table 2: Smoke Developed Summary: Echo Barrier H9 components (Sides only)

Test No.	Test Code	Sample Description	CSD Calculated Smoke Developed (Prior to Floor Ignition)	SDI Smoke Developed Index (Prior to Floor Ignition)	CSD Calculated Smoke Developed (Entire Test Duration)	SDI Smoke Developed Index (Entire Test Duration)
1	02151803	H10 Back side	8.2	10	511.4	Over 500
2	02151807	H10 Front side	16.7	15	557.6	Over 500

**Note: CS Cutting Station and Compact Cutting Station roof component, vinyl doors and windows – Smoke Performance: Class B1 = German DIN 4102 B1**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate is level, smooth, capable of supporting units and imposed loads and ready to receive work of this section.
- B. Verify gradients and elevations of substrate are correct.
- C. Beginning installation means acceptance of conditions.

3.2 INSTALLATION

- A. Install in strict accordance with manufacturer's published instructions for specific installation conditions.

END OF SECTION 130800



**SECTION 130800 – EXTERIOR NOISE BARRIER / ABSORBER**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Exterior noise barrier/absorber.
- B. Related Sections:

Keep below for temporary fencing application.

- 1. Division 1 Section “Temporary Facilities and Controls” for installation of exterior noise barrier/absorber on temporary fencing.

1.2 SUBMITTALS

- A. Product Data: For each type of noise barrier/absorber material, and mounting indicated.

1.3 DEFINITIONS

- A. Noise Reduction Coefficient (NRC): A single number index used to rate materials for their effectiveness in absorbing sound per ASTM C423 Standard Method of Test.
- B. Sound Transmission Coefficient (STC) : A single number index used to rate a partition's resistance to airborne sound transfer at the frequencies between 125 - 5000 Hz, as per ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements, ASTM E413 Classification for Rating Sound Insulation.
- C. Sound Transmission Loss (TL): The reduction of sound pressure at the frequencies between 125 - 4000 Hz, as per ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide baffle units and installation components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical components with appropriate markings of applicable testing and inspecting organization.
  - 1. Surface Burning Characteristics: As follows for Class A, tested per ASTM E 84.
    - a. Flame Spread: 0 - 25.
    - b. Smoke Developed: 0 - 450.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver noise barrier/absorber to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Handle noise barrier/absorber carefully to avoid scratching or damaging units in any way.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Exterior Noise Barrier/Absorber:
  - 1. Echo Barrier H9 by Echo Barrier USA, LLC (Basis of Design)
    - a. 150 North Michigan Avenue, Suite 2800, Chicago, Illinois 60601
    - b. 1-603-930-3366
    - c. Toll Free: 1-800-728-9098
  - 2. Or equal.

2.2 EXTERIOR NOISE BARRIER/ABSORBER

- A. Acoustic Fill:
  - 1. Foam, non-corrosive, resistant to attack by fungus, vermin proof and non-hygroscopic.
  - 2. Free draining, self-supporting and shall retain physical and sound absorptive characteristics after long term exposure to the elements.
  - 3. Class A Fire Rating with a Flame Spread not greater than 25.
- B. Size: 53 inches x 81 inches.
- C. Weight: 11.7 lbs or 0.39 lbs per square foot
- D. Weatherproof: Water resistant to IPX6 and IPX9 BS EN 60529:1992.
  - 1. **IPX6 – Protected Against Powerful Water Jets**; After testing, the barrier was dried externally before being opened for internal inspection. Slight water ingress was noted along edges of perimeter stitching and inner absorbent material. The amount found was not deemed sufficient to impair operation.
  - 2. **IPX9 – High Pressure and Temperature Water Jets**; After testing, the specimen was dried externally before being cut open for internal inspection. No water ingress was found
- E. Accessories: Quick hook system and custom elastic ties or zip ties
- F. Installation: One person in 30 seconds with installation accessories or 60 seconds with zip ties
- G. Tensile Test (ISO 17025): 5.85 kN vertical, 1.10kN horizontal
- H. Cold resistant: minus 40 degrees - The specimen completed testing in according with specification BS EN 60068-2-1:2007 test Ab , with no visible signs of external damage or degradation

- I. Debris and Dust resistance – Debris and Dust resistant to IP4X and IP5X requirements BS 6052:1992
  - 1. **IP4X - Protected Against Access to Hazardous Parts and Against Solid Foreign Objects ;**  
The barrier was found to have no openings that could be penetrated by the access probe of 3/64” diameter reducing adequate clearance between the access probe and hazardous parts.
  - 2. **IP5X - Protected Against Access to Solid Foreign Objects – Dust Protected ;** After testing, the barrier was cleaned externally before being cut open for internal inspection. No dust ingress was found in the absorber material.
- J. UV resistant: 3 years
- K. Night-time reflective strips: Yes
- L. Non-hazardous materials: Yes
- M. Reusable: Yes
- N. Recyclable materials: Yes
- O. Security: Unique RFID number in each acoustic barrier, anti-theft security cable
- P. Safety: All warning and hazard labels clearly printed on barrier at eye level
- Q. Manufacturer’s Warranty: 24-month barrier warranty - The PVC front outer layer will come with a separate 36-month UV resistant manufacturer’s warranty.
- R. Manuals: Complete installation and operation manuals shall accompany each unit via a QR code printed on the front outer layer of the barrier
- S. Maintenance: The barrier shall not require any special cleaning products and shall be easily cleaned with a high-pressure water spray (up to 80-100psi). A cleaning solution can be used for graffiti removal
- T. Heavy duty, rust resistant brass metallic grommets with 1-inch diameter opening (CUI 64% ZN 36%)
- U. Thread – a heat-resistant, non-melting, self-extinguishing sewing thread, made from continuous filament meta-aramide of the brand DuPont™ NOMEX (or similar) for high temperatures- The long-term heat resistance is approximately 428°F and decomposition temperature is approximately 698°F
- V. Applications: Construction & demolition projects; rail and road construction/maintenance; utility works/maintenance; site refurbishments/renovations, general building maintenance, music, sports and other public events; loading and unloading areas; outdoor gun ranges, airports and heliports.

2.3 ACOUSTICAL PERFORMANCE

A. Sound Absorption Coefficients per ASTM C423:

1/1 Octave Band Center Frequency (Hz)	125	250	500	1K	2K	4K	8K	NRC
Echo Barrier Panel H9 single layer	0.13	0.5	0.86	0.33	0.2	0.12	-	0.45

B. Sound Transmission Loss (dB) per ASTM E90 & Sound Transmission Class (STC):

1/1 Octave Band Center Frequency (Hz)	Sound Transmission Loss ( TL )							STC
	125	250	500	1K	2K	4K	8K	
Echo Barrier Panel H9 single layer	8.7	9.9	9.1	19.7	30.3	36.9	-	16
Echo Barrier Panel H9 double layer	11.7	12.9	12.1	22.7	33.3	39.9	-	19

2.4 FIRE AND SMOKE PERFORMANCE

“Test for Surface Burning Characteristics of Building Materials”, (ASTM E84)

A. Table 1: Flame Spread Summary

Test No.	Test Code	Sample Description	CFS Calculated Flame Spread Ceiling	FSI Flame Spread Index (Ceiling)+	CFS Calculated Flame Spread (Floor)	FSI Flame Spread Index (Floor) ++
1	02151811	H9 Back side	7.42	5	157.96	160
2	02151807	H9 Front side	14.90	15	142.77	145

+ Flame Spread Index while material remained in the original test position.

++ Ignition of molted residue on the furnace floor resulted in flame travel equivalent to calculated Flame Spread Index

B. Table 2: Smoke Developed Summary

Test No.	Test Code	Sample Description	CSD Calculated Smoke Developed (Prior to Floor Ignition)	SDI Smoke Developed Index (Prior to Floor Ignition)	CSD Calculated Smoke Developed (Entire Test Duration)	SDI Smoke Developed Index (Entire Test Duration)
1	02151803	H10 Back side	8.2	10	511.4	Over 500
2	02151807	H10 Front side	16.7	15	557.6	Over 500

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify substrate is level, smooth, capable of supporting units and imposed loads and ready to receive work of this section.
- B. Verify gradients and elevations of substrate are correct.
- C. Beginning installation means acceptance of conditions.

**3.2 INSTALLATION**

- A. Install in strict accordance with manufacturer's published instructions for specific installation conditions.

END OF SECTION 130800

**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. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. 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 Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

**2.2 SLEEVE-SEAL SYSTEMS**

- A. 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.

### 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.4 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.
  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.

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

**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. Piping Smaller Than NPS 6: Cast-iron wall sleeves or Galvanized-steel wall sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: 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.
  - 3. Concrete Slabs-on-Grade:



- a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Sleeve-seal fittings.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 and Larger: 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 above Grade:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, Stack-sleeve fittings or Sleeve-seal fittings.
  - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.
5. Interior Partitions:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

**SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
    - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
    - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
  - 2. Escutcheons for Existing Piping:
    - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
    - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    - e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
    - g. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
    - h. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.  
END OF SECTION

**SECTION 220523.12 - BALL 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. Brass ball valves.
  - 2. Bronze ball valves.
  - 3. Steel ball valves.
  - 4. Iron ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

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 soldered ends.
  - 3. Set ball 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.5 for flanges on steel valves.
  - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  - 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

- A. One-Piece, Brass Ball Valves:
  - 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 400 psig.
    - c. Body Design: One piece.
    - d. Body Material: Forged brass or bronze.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Brass or stainless steel.
    - h. Ball: Chrome-plated brass or stainless steel.
    - i. Port: Reduced.

**B. Two-Piece, Brass Ball Valves with Full Port and Brass Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

**C. Two-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

**D. Three-Piece, Brass Ball Valves with Full Port and Brass Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Three piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

**E. Three-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Three piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

**2.3 BRONZE BALL VALVES**

**A. One-Piece, Bronze Ball Valves with Bronze Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 400 psig.
  - c. Body Design: One piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Bronze.
  - h. Ball: Chrome-plated brass.
  - i. Port: Reduced.

**B. One-Piece, Bronze Ball Valves with Stainless-Steel Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: One piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Reduced.

**C. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Bronze or brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

**D. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded or soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

**E. Three-Piece, Bronze Ball Valves with Full Port and Bronze or Brass Trim:**

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Three piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Bronze or brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

F. Three-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Three piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

G. Two-Piece, Safety-Exhaust, Bronze Ball Valves:

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Bronze, ASTM B 584, Alloy C844.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
  - i. Port: Full.

## 2.4 STEEL BALL VALVES

A. Class 150, Steel Ball Valves with Full Port:

1. Description:
  - a. Standard: MSS SP-72.
  - b. CWP Rating: 285 psig.
  - c. Body Design: Split body.
  - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
  - e. Ends: Flanged or threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

B. Class 150, Steel Ball Valves with Regular Port:

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1. Description:
  - a. Standard: MSS SP-72.
  - b. CWP Rating: 285 psig.
  - c. Body Design: Uni-body.
  - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
  - e. Ends: Flanged or threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Regular.

## 2.5 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
  1. Description:
    - a. Standard: MSS SP-72.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Split body.
    - d. Body Material: ASTM A 126, gray iron.
    - e. Ends: Flanged or threaded.
    - f. Seats: PTFE.
    - g. Stem: Stainless steel.
    - h. Ball: Stainless steel.
    - i. Port: Full.

## 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 valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

**3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves 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.

**3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 PSIG OR LESS)**

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. One piece, brass ball valve.
  - 3. One piece, bronze ball valve with stainless-steel trim.
  - 4. Two-piece, brass ball valves with full port and stainless-steel trim.
  - 5. Two-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
  - 6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
  - 7. Three-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
  - 8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Class 150, steel ball valves with full port.
  - 3. Class 150, iron ball valves.

**3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)**

- A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze or stainless-steel trim.
4. Two-piece, brass ball valves with full port and brass or stainless-steel trim.
5. Two-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze or stainless-steel trim.
4. Two-piece, brass ball valves with full port and brass or stainless-steel trim.
5. Two-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

END OF SECTION 220523.12

**SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. 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 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment 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.

#### 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 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 stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless 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. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturred 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 stainless steel.
6. Metallic Coating: Electroplated zinc, Hot-dipped galvanized or Mill galvanized.
7. Paint Coating: Vinyl.
8. Plastic Coating: PVC.
9. Combination Coating: Galvanized and PVC coated.

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: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, 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-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

**2.7 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

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### 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

### 2.9 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. 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. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. 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 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. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint 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 A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg. F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg. F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include

auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

**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.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.
  - 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: Black.
  - 3. Background Color: White.
  - 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.
- 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.

**2.4 STENCILS**

- A. Stencils for Piping:
  - 1. Lettering Size: Size letters according to ASME A13.1 for piping.
  - 2. Stencil Material: Fiberboard or metal.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

**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: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link 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: 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 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. Piping Color Coding: Painting of piping is specified in [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- B. 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.
- C. 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 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. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
1. Low-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  2. High-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  3. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  4. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Safety purple.
    - b. Letter Color: White.
  5. Natural Gas Piping:
    - a. Background Color: Safety yellow.
    - b. Letter Color: Black.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, 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: 2 inches round.
    - b. Hot Water: 2 inches round.
    - c. Low-Pressure Compressed Air: 2 inches square.
    - d. High-Pressure Compressed Air: 2 inches square.
  2. Valve-Tag Colors:
    - a. Cold Water: Natural or Safety green.

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- b. Hot Water: Natural or Safety green.
- c. Low-Pressure Compressed Air: Safety blue.
- d. High-Pressure Compressed Air: Safety blue.

### 3. Letter Colors:

- a. Cold Water: Black on Natural Tag or White on Safety Green Tag.
- b. Hot Water: Black on Natural Tag or White on Safety Green Tag.
- c. Low-Pressure Compressed Air: White.
- d. High-Pressure Compressed Air: White.

### 3.6 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. Sanitary waste piping exposed to freezing conditions.
  - 5. Storm-water piping exposed to freezing conditions.
  - 6. Roof drains and rainwater leaders.
  - 7. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment Insulation."

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, 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, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
  - 3. Sheet Jacket Materials: 12 inches square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

#### 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. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
  1. Piping Mockups:
    - a. One 10-foot section of NPS 2 straight pipe.
    - b. One each of a 90-degree threaded, welded, and flanged elbow.
    - c. One each of a threaded, welded, and flanged tee fitting.
    - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
    - e. Four support hangers including hanger shield and insert.
    - f. One threaded strainer and one flanged strainer with removable portion of insulation.
    - g. One threaded reducer and one welded reducer.
    - h. One pressure temperature tap.
    - i. One mechanical coupling.
  2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  4. Obtain Architect's approval of mockups before starting insulation application.

5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockups when directed.
- D. 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 Section 220529 "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, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Block Insulation: ASTM C 552, Type I.
  - 2. Special-Shaped Insulation: ASTM C 552, Type III.
  - 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 4. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- H. 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 I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. 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, **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Phenolic:
  - 1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
  - 2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
  - 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
  - 4. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

## 2.3 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.



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- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg. F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg. F.
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg. F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  - 2. Service Temperature Range: 0 to 180 deg. F.
  - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  - 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg. F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

### 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  - 3. Service Temperature Range: 0 to plus 180 deg. F.
  - 4. Color: White.

2.6 SEALANTS

- A. Joint Sealants for Cellular-Glass and Phenolic Products:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg. F.
  - 4. Color: White or gray.
  
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg. F.
  - 4. Color: White.

2.7 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.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd.

2.10 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. Adhesive: As recommended by jacket material manufacturer.
  - 2. Color: White.
  - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

- C. 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.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.

2.12 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
  - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 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.

2.13 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  - 1. 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. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg. F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

**3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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 inches 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**

- 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 below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
  
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
  
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
  
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
  
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
  
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "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 CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 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.

3.8 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.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.10 INSTALLATION OF POLYOLEFIN INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.11 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 PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. 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.

**3.12 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  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.

**3.13 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, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

**3.14 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

**3.15 INDOOR PIPING INSULATION SCHEDULE**

**A. Domestic Cold Water:**

1. NPS 1 and Smaller: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - c. Phenolic: 1 inch thick.
  - d. Polyolefin: 1 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - c. Phenolic: 1 inch thick.
  - d. Polyolefin: 1 inch thick.

**B. Domestic Hot and Recirculated Hot Water:**

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - c. Phenolic: 1 inch thick.
  - d. Polyolefin: 1 inch thick.
2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Flexible Elastomeric: 1 inch thick.
  - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - d. Phenolic: 1 inch thick.
  - e. Polyolefin: 1 inch thick.

**C. Stormwater and Overflow:**

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Flexible Elastomeric: 1 inch thick.
  - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - d. Phenolic: 1 inch thick.
  - e. Polyolefin: 1 inch thick.

**D. Roof Drain and Overflow Drain Bodies:**

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Cellular Glass: 1-1/2 inches thick.
  - b. Flexible Elastomeric: 1 inch thick.
  - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - d. Phenolic: 1 inch thick.
  - e. Polyolefin: 1 inch thick.

- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

**3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. PVC: 20 mils thick.

**3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET**

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

**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.

B. Related Requirements:

- 1. Section 221113 "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.

**1.5 FIELD CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than three days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Construction Manager's and Owner's written permission.

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 Annex G. 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. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. 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.
- G. Copper Pressure-Seal-Joint Fittings:
  - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- H. Copper Push-on-Joint Fittings:
  - 1. Description:
    - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
    - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.
- I. Copper-Tube, Extruded-Tee Connections:
  - 1. Description: Tee formed in copper tube according to ASTM F 2014.
- J. Appurtenances for Grooved-End Copper Tubing:
  - 1. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.



2. Mechanical Couplings for Grooved-End Copper Tubing:
  - a. Copper-tube dimensions and design similar to AWWA C606.
  - b. Ferrous housing sections.
  - c. EPDM-rubber gaskets suitable for hot and cold water.
  - d. Bolts and nuts.
  - e. Minimum Pressure Rating: 300 psig.

## 2.3 GALVANIZED-STEEL PIPE AND FITTINGS

### A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

### B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

### C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

### D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

### E. Flanges: ASME B16.1, Class 125, cast iron.

### F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

1. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
2. Fittings for Grooved-End, Galvanized-Steel Pipe:
  - a. AWWA C606 for steel-pipe dimensions.
  - b. Ferrous housing sections.
  - c. EPDM-rubber gaskets suitable for hot and cold water.
  - d. Bolts and nuts.
  - e. Minimum Pressure Rating:
    - 1) NPS 8 and Smaller: 600 psig.
    - 2) NPS 10 and NPS 12: 400 psig.
    - 3) NPS 14 to NPS 24: 250 psig.

## 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.

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- 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 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.

### 2.6 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. Standard: ASSE 1079.
  - 2. Pressure Rating: 150 psig.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Standard: ASSE 1079.
  - 2. Factory-fabricated, bolted, companion-flange assembly.
  - 3. Pressure Rating: 150 psig.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 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.
- E. Dielectric Nipples:
  - 1. Standard: IAPMO PS 66.
  - 2. Electroplated steel nipple complying with ASTM F 1545.

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3. Pressure Rating and Temperature: 300 psig at 225 deg. F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "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 copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install 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 Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "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 Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

- M. Install piping to permit valve servicing.
- N. 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.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- T. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. 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."

- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. 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.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. 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.
- L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 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, nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
    - 1. Vertical Piping: MSS Type 8 or 42, clamps.
    - 2. Individual, Straight, Horizontal Piping Runs:
      - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
    - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
    - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
  - C. Support vertical piping and tubing at base and at each floor.
  - D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
  - E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
    - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
    - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
    - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
    - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
    - 6. NPS 6: 10 feet with 5/8-inch rod.
    - 7. NPS 8: 10 feet with 3/4-inch rod.
  - F. Install supports for vertical copper tubing every 10 feet.
  - G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
    - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
    - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
    - 3. NPS 2: 10 feet with 3/8-inch rod.
    - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
    - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
    - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
    - 7. NPS 6: 12 feet with 3/4-inch rod.
    - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
  - H. Install supports for vertical steel piping every 15 feet.
  - I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 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.
  - 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 Section 220553 "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 three days 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. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

**3.12 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:
- 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 shall be one of the following:
- 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
  - 2. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
  - 3. Push-on-joint, ductile-iron pipe; standard-pattern, push-on-joint fittings; and gasketed joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
- 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
  - 2. Push-on-joint, ductile-iron pipe; standard-pattern, push-on-joint fittings; and gasketed joints.
- G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
- 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed or flared joints.
- H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.
- I. Aboveground domestic water piping, NPS 2-1/2 and Larger, shall be one of the following:
    1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
    2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
    3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
    4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
    5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
  - J. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
    1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
    2. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

### 3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end 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. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Ground hydrants.
12. Post hydrants.
13. Drain valves.
14. Water-hammer arresters.
15. Air vents.
16. Trap-seal primer valves.
17. Trap-seal primer systems.
18. Specialty valves.
19. Flexible connectors.
20. Water meters.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.

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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 Annex G and NSF 14. Mark "NSF-pw" on plastic piping components.

### 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. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome plated.

- B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

- C. Laboratory-Faucet Vacuum Breakers:

1. Standard: ASSE 1035.
2. Size: NPS 1/4 or NPS 3/8, matching faucet size.
3. Body: Bronze.
4. End Connections: Threaded.
5. Finish: Chrome plated.

- D. Spill-Resistant Vacuum Breakers:

1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.
3. Size: NPS 3/4.
4. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## 2.4 BACKFLOW PREVENTERS

### A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 or NPS 3/4.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Chrome plated / Rough bronze.

### B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Size: *Insert* NPS.
5. Design Flow Rate: *Insert* gpm.
6. Selected Unit Flow Range Limits: *Insert* gpm.
7. Pressure Loss at Design Flow Rate: *Insert* psig for sizes NPS 2 and smaller; *Insert* psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### C. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Size: *Insert* NPS.
5. Design Flow Rate: *Insert* gpm.
6. Selected Unit Flow Range Limits: *Insert* gpm.
7. Pressure Loss at Design Flow Rate: *Insert* psig for sizes NPS 2 and smaller; *Insert* psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:

- a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
- b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4.
4. Body: Stainless steel.
5. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 or NPS 3/4.
4. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4.
4. Body: Stainless steel.
5. End Connections: Threaded.

G. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

H. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Size: *Insert* NPS.
4. Design Flow Rate: *Insert* gpm.
5. Design Inlet Pressure: *Insert* psig.
6. Design Outlet Pressure Setting: *Insert* psig.
7. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
8. Valves for Booster Heater Water Supply: Include integral bypass.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:

1. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
  - a. Size: *Insert* NPS.
  - b. Pattern: Angle or Globe-valve design.
  - c. Trim: Stainless steel.
4. Design Flow: *Insert* gpm.
5. Design Inlet Pressure: *Insert* psig.
6. Design Outlet Pressure Setting: *Insert* psig.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.

3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: *Insert* deg. F.
8. Tempered-Water Design Flow Rate: *Insert* gpm.
9. Valve Finish: Chrome plated / Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: [Exposed-mounted] [Cabinet-type], thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: *Insert* deg. F.
8. Tempered-Water Design Flow Rate: *Insert* gpm.
9. Selected Valve Flow Rate at 45-psig Pressure Drop: *Insert* gpm.
10. Pressure Drop at Design Flow Rate: *Insert* psig.
11. Valve Finish: **[Chrome plated]** **[Rough bronze]**.
12. Piping Finish: **[Chrome plated]** **[Copper]**.
13. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

1. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in two-valve parallel arrangement.
2. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
3. Small-Flow Parallel: Thermostatic, water mixing valve.
4. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
5. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
6. Pressure Rating: 125 psig minimum unless otherwise indicated.
7. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
8. Selected Large-Flow, Tempered-Water Valve Size: *<Insert size>*.
9. Tempered-Water Setting: *<Insert deg. F>*.
10. Unit Tempered-Water Design Flow Rate: *<Insert gpm>*.
11. Unit Minimum Tempered-Water Design Flow Rate: *<Insert gpm>*.
12. Selected Unit Flow Rate at 45-psig Pressure Drop: *<Insert gpm>*.
13. Unit Pressure Drop at Design Flow Rate: *<Insert psig>*.
14. Unit Tempered-Water Outlet Size: *<Insert NPS>* end connection.
15. Unit Hot- and Cold-Water Inlet Size: *<Insert NPS>* end connections.
16. Thermostatic Mixing Valve and Water Regulator Finish: [Chrome plated] [Rough bronze].
17. Piping Finish: [Chrome plated] [Copper].

D. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.



4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: <Insert deg. F>.
8. Tempered-Water Design Flow Rate: <Insert gpm>.

E. Primary Water Tempering Valves:

1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze.
4. Temperature Control: Manual.
5. Inlets and Outlet: Threaded.
6. Selected Primary Water Tempering Valve Size: <Insert size>.
7. Tempered-Water Setting: <Insert deg. F>.
8. Tempered-Water Design Flow Rate: <Insert gpm>.
9. Pressure Drop at Design Flow Rate: <Insert psig>.
10. Tempered-Water Outlet Size: <Insert NPS> end connection.
11. Cold-Water Inlet Size: <Insert NPS> end connection.
12. Hot-Water Inlet Size: <Insert NPS> end connection.
13. Valve Finish: Rough bronze.

## 2.8 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. Drain: Pipe plug or factory-installed, hose-end drain valve.

## 2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel, epoxy-painted-steel or stainless-steel box and faceplate.
3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
4. Supply Shutoff Fittings: NPS 1/2 ball valves and NPS 1/2 copper, water tubing.
5. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
6. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
7. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

**2.10 HOSE BIBBS**

**A. Hose Bibbs:**

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

**2.11 WALL HYDRANTS**

**A. Non-freeze Wall Hydrants:**

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: [Polished nickel bronze] [Chrome plated].
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

**B. Vacuum Breaker Wall Hydrants:**

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4.
8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.12 GROUND HYDRANTS

A. Non-freeze Ground Hydrants:

1. Standard: ASME A112.21.3M.
2. Type: Non-freeze, concealed-outlet ground hydrant with box.
3. Operation: Loose key.
4. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
5. Inlet: NPS 3/4.
6. Outlet: Garden-hose thread complying with ASME B1.20.7.
7. Drain: Designed with hole to drain into ground when shut off.
8. Box: Standard pattern with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Operating Key(s): Two with each ground hydrant.
11. Vacuum Breaker: ASSE 1011.

2.13 POST HYDRANTS

A. Non-freeze, Draining-Type Post Hydrants:

1. Standard: ASME A112.21.3M.
2. Type: Non-freeze, exposed-outlet post hydrant.
3. Operation: Loose key.
4. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
5. Casing: Bronze with casing guard.
6. Inlet: NPS 3/4.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. Drain: Designed with hole to drain into ground when shut off.
9. Vacuum Breaker:
  - a. Non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
10. Operating Key(s): Two with each loose-key-operation wall hydrant.

2.14 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.15 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: [Metal bellows] [Copper tube with piston].
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.16 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. 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. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
2. Size: NPS 1-1/4 minimum.
3. Material: Chrome-plated, cast brass.

2.17 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

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1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

### 2.18 WATER METERS

#### A. Displacement-Type Water Meters:

1. Description:
  - a. Standard: AWWA C700.
  - b. Pressure Rating: 150-psig working pressure.
  - c. Body Design: Nutating disc; totalization meter.
  - d. Registration: In gallons or cubic feet as required by utility company.
  - e. Case: Bronze.
  - f. End Connections: Threaded.

#### B. Turbine-Type Water Meters:

1. Description:
  - a. Standard: AWWA C701.
  - b. Pressure Rating: 150-psig working pressure.
  - c. Body Design: Turbine; totalization meter.
  - d. Registration: In gallons or cubic feet as required by utility company.
  - e. Case: Bronze.
  - f. End Connections for Meters NPS 2 and Smaller: Threaded.
  - g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

#### C. Compound-Type Water Meters:

1. Description:
  - a. Standard: AWWA C702.
  - b. Pressure Rating: 150-psig working pressure.
  - c. Body Design: With integral mainline and bypass meters; totalization meter.
  - d. Registration: In gallons or cubic feet as required by utility company.
  - e. Case: Bronze.
  - f. Pipe Connections: Flanged.

#### D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

#### E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

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 water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. 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.
- F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. *Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."*
- H. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- I. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- J. Install water-hammer arresters in water piping according to PDI-WH 201.
- K. 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.
- L. 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.

**3.2 CONNECTIONS**

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

**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. Water pressure-reducing valves.
  - 2. Calibrated balancing valves.
  - 3. Primary, thermostatic, water mixing valves.
  - 4. Manifold, thermostatic, water mixing-valve assemblies.
  - 5. Primary water tempering 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 Section 220553 "Identification for Plumbing Piping and Equipment."

**3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each backflow preventer 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 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.

B. Related Sections:

- 1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
- 2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
- 3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

- 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- 2. Waste, Force-Main Piping: 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.

B. *LEED Submittals:*

- 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."



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### 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.

### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than three days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's and Owner's written permission.

## 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.

2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and ASTM C 1540.
2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Standard: ASTM C 1277.
2. 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.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 DUCTILE-IRON PIPE AND FITTINGS

- A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

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. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 150 psig.
    - 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: 150 psig.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- 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 Sanitary 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 Sanitary Drainage Piping: 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.
  - 3. 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."
- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- R. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- S. Install force mains at elevations indicated.
- T. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

**3.3 JOINT CONSTRUCTION**

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- F. 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 Aboveground Force Main Piping: Fitting-type transition couplings.
  - 3. In Underground Force Main Piping:
    - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

**3.5 VALVE INSTALLATION**

- A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  - 3. Install gate valve for piping NPS 2-1/2 and larger.

- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
  - 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
  - 5. NPS 6: 10 feet with 5/8-inch rod.
  - 6. NPS 8: 10 feet with 3/4-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.
- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
  - 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.



- D. Connect force-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main.
  - 2. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- 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 four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 3 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  4. Copper DWV tube, copper drainage fittings, and soldered joints.
  5. Dissimilar Pipe-Material Couplings: transition couplings.
- C. Aboveground, soil and waste piping NPS 4 and larger shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: transition couplings.
- D. Aboveground, vent piping all sizes shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

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2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  4. Copper DWV tube, copper drainage fittings, and soldered joints.
  5. Dissimilar Pipe-Material Couplings: transition couplings.
- E. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, cast-iron hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: transition couplings.
- F. Underground, soil and waste piping NPS 4 and larger shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; heavy-duty, cast-iron hubless-piping couplings; coupled joints.
  3. Dissimilar Pipe-Material Couplings: transition couplings.
- G. Aboveground sanitary-sewage force mains all sizes shall be the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
- H. Underground sanitary-sewage force mains all sizes shall be any of the following:
1. Ductile-iron, mechanical-joint piping and mechanical joints.
  2. Ductile-iron, push-on-joint piping and push-on joints.

END OF SECTION 221316

**SECTION 224213.13 - COMMERCIAL WATER CLOSETS**

**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. Water closets.
  - 2. Flushometer valves.
  - 3. Toilet seats.

**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 water closets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

**PART 2 - PRODUCTS**

**2.1 WATER CLOSETS**

- A. Water Closets: Floor mounted flushometer, bottom outlet, top spud.

1. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
2. Refer to architectural drawings for performance and Basis of Design.
  - a. Color: Per Architect.

## 2.2 FLUSHOMETER VALVES

### A. Manual and Sensor-operated Flushometer Valves:

1. Standard: ASSE 1037.
2. Refer to architectural drawings for performance and Basis of Design.

## 2.3 TOILET SEATS

### A. Toilet Seats:

1. Standard: IAPMO/ANSI Z124.5.
2. Material: Plastic.
3. Type: Commercial (Heavy duty).
4. Shape: Elongated rim, open front.
5. Hinge Material: Noncorroding metal.
6. Seat Cover: Not required.
7. Color: To match fixture.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

#### B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between water closets and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

**SECTION 224216.13 - COMMERCIAL LAVATORIES**

**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. Lavatories.
- 2. Faucets.
- 3. Supports.

**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 lavatories.
- 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 LAVATORIES**

- A. Lavatory: Vitreous china, wall mounted.

- 1. Standard: ASME A112.19.2/CSA B45.1.
- 2. Refer to drawings for performance and Basis of Design.

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3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on architectural drawings or comparable product.

### 2.2 FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Commercial, solid-brass valve.
  1. Standard: ASME A112.18.1/CSA B125.1.
  2. Refer to drawings for performance and Basis of Design.
  3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product.

### 2.3 SUPPORTS

- A. Type II Lavatory Carrier:
  1. Standard: ASME A112.6.1M.
- B. Type III Lavatory Carrier:
  1. Standard: ASME A112.6.1M.

### 2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. NPS 1/2.
  2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces.

### 2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.



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- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material: Chrome-plated, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
  - 3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

#### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

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### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

**SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Flexible, ball-joint, packed expansion joints.
  - 2. Grooved-joint expansion joints.
  - 3. Pipe loops and swing connections.
  - 4. 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.

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### 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. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 PACKED EXPANSION JOINTS

- A. Flexible, Ball-Joint, Packed Expansion Joints:
  - 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. Advanced Thermal Systems, Inc.
    - b. Hyspan Precision Products, Inc.
  - 2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
  - 3. Material: Carbon-steel assembly with asbestos-free composition packing.
  - 4. Design: For 360-degree rotation and angular deflection.
  - 5. Minimum Pressure Rating: 250 psig at 400 deg F.
  - 6. Angular Deflection for NPS 6 and Smaller: 30 degree minimum.
  - 7. Angular Deflection for NPS 8 and Larger: 15 degree minimum.
  - 8. End Connections for NPS 2 and Smaller: Threaded.
  - 9. End Connections for NPS 2-1/2 and Larger: Flanged.

### 2.2 GROOVED-JOINT EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International, Inc.
  - 2. Victaulic Company.
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: 10 flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

**2.3 ALIGNMENT GUIDES AND ANCHORS**

**A. Alignment Guides:**

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

**B. Anchor Materials:**

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

**PART 3 - EXECUTION**

**3.1 EXPANSION-JOINT INSTALLATION**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install grooved-joint expansion joints to grooved-end steel piping

**3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION**

- A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four 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. Attach guides to pipe and secure guides to building structure.
- C. 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.
- D. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- E. 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.
- F. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

**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. Sleeve-seal fittings.
  - 4. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

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. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, 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.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. 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.
  2. 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. 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 AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: 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. Piping Smaller Than NPS 6: 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. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - 5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 230517

**SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**PART 2 - PRODUCTS**

**2.1 ESCUTCHEONS**

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

**2.2 FLOOR PLATES**

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  2. Escutcheons for Existing Piping:
    - a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - d. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.
  2. Existing Piping: Split-casting, floor-plate type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

**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. Thermowells.
  3. Dial-type pressure gages.
  4. Gage attachments.
  5. Test plugs.
  6. Test-plug kits.

**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, Industrial-Style, Liquid-in-Glass Thermometers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flo Fab Inc.
    - b. Tel-Tru Manufacturing Company.
  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 or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
  - a. 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 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.
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. Ernst Flow Industries.
  - d. Flo Fab Inc.
  - e. Palmer Wahl Instrumentation Group.
  - f. REOTEMP Instrument Corporation.
  - g. Tel-Tru Manufacturing Company.
  - h. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); 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.

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7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 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 porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. 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. Peterson Equipment Co., Inc.
  3. Trerice, H. O. Co.
  4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  5. 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. National Meter, Inc.
  3. Peterson Equipment Co., Inc.
  4. Trerice, H. O. Co.
  5. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  6. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), 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.

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- C. 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.
- D. 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.
- E. Carrying Case: Metal or plastic, with formed instrument padding.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid 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 direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install permanent indicators on walls or brackets in accessible and readable positions.
- J. Install connection fittings in accessible locations for attachment to portable indicators.
- K. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler.
  - 3. Inlet and outlet of each hydronic coil in air-handling units.
  - 4. Inlet and outlet of each terminal unit coil.
- L. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Suction and discharge of each 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.

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### 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 Heating, Hot-Water Piping: 30 to 240 deg F.

### 3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 0 to 100 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. Bronze ball valves.
  - 2. Iron ball valves.
  - 3. Iron, grooved-end butterfly valves.
  - 4. Bronze swing check valves.
  - 5. Iron swing check valves.
  - 6. Iron gate valves.
  - 7. Bronze globe valves.
  - 8. Iron globe valves.
  - 9. Water pressure-reducing valves.
  - 10. Chainwheels.
- B. Related Sections:
  - 1. Section 230553 "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 ACTION SUBMITTALS**

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 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. Handwheel: For valves other than quarter-turn types.
  - 2. Handlever: For quarter-turn valves NPS 6 and smaller.
  - 3. 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 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Hammond Valve.
  - d. NIBCO INC.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

2.3 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Valve, Inc.
  - b. Sure Flow Equipment Inc.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
  - a. Standard: MSS SP-72.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Split body.
  - d. Body Material: ASTM A 126, gray iron.
  - e. Ends: Flanged.
  - f. Seats: PTFE or TFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel.
  - i. Port: Full.

## 2.4 IRON, GROOVED-END BUTTERFLY VALVES

### A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Kennedy Valve; a division of McWane, Inc.
  - b. Tyco Fire Products LP; Grinnell Mechanical Products.
  - c. Victaulic Company.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 175 psig.
  - c. Body Material: Coated, ductile iron.
  - d. Stem: Two-piece stainless steel.
  - e. Disc: Coated, ductile iron.
  - f. Seal: EPDM.

## 2.5 BRONZE SWING CHECK VALVES

### A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.

- f. Disc: Bronze.

## 2.6 IRON SWING CHECK VALVES

### A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. NPS 2-1/2 to NPS 12, 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.

## 2.7 IRON GATE VALVES

### A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Flo Fab Inc.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. NPS 2-1/2 to NPS 12, 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.

## 2.8 BRONZE GLOBE VALVES

### A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, 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 and Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron, bronze, or aluminum.

## 2.9 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## 2.10 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Honeywell Water Controls
  - b. Watts Industries, Inc.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Size: Per drawings.
4. Design Flow Rate: Per drawings.
5. Design Inlet Pressure: Per drawings.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

#### 2.11 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Babbitt Steam Specialty Co.
  2. Roto Hammer Industries.
  3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  2. Attachment: For connection to ball butterfly and plug valve stems.
  3. Sprocket Rim with Chain Guides: Ductile 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 ball butterfly gate 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.

### 3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Throttling Service: Globe, ball, or butterfly valves.
3. Throttling Service, Steam: Globe or butterfly valves.
4. Pump-Discharge Check Valves:
  - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
  - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends or solder-joint valve-end.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Steel Piping, NPS 5 and Larger: Flanged ends.
4. For Grooved-End Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

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 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
2. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal 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.

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.

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 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: Pre-galvanized or hot dipped.
  - 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 4. 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. MFMA Manufacturer Metal Framing Systems:**

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. 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.
2. **Description:** Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. **Standard:** MFMA-4.
4. **Channels:** Continuous slotted steel channel with in-turned lips.
5. **Channel Nuts:** Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. **Hanger Rods:** Continuous-thread rod, nuts, and washer made of carbon steel.
7. **Metallic Coating:** Hot-dipped galvanized.

**B. Non-MFMA Manufacturer Metal Framing Systems:**

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International; a subsidiary of Mueller Water Products Inc.
  - b. Empire Industries, Inc.
  - c. ERICO International Corporation.
  - d. Haydon Corporation; H-Strut Division.
  - e. NIBCO INC.
  - f. PHD Manufacturing, Inc.
  - g. PHS Industries, Inc.
2. **Description:** Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. **Standard:** Comply with MFMA-4.
4. **Channels:** Continuous slotted steel channel with in-turned lips.
5. **Channel Nuts:** Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. **Hanger Rods:** Continuous-thread rod, nuts, and washer made of carbon steel.

**2.4 THERMAL-HANGER SHIELD INSERTS**

**A. Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.

3. ERICO International Corporation.
  4. PHS Industries, Inc.
  5. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  6. Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 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, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.6 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. 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: Plastic.
  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.
- C. 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.

- D. 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.

## 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. 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.
- 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. Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - b. 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. 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.
  4. 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 corrosion-resistant attachments for hostile environment applications.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. 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.
  - 3. 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.
  - 4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 5. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 6. 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.
- 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 long ends are required for riser clamps.
- K. 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:



1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. 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.
- N. Comply with MSS SP-69 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 230529

**SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Freestanding and restrained spring isolators.
  - 2. Spring hangers.
  - 3. Spring hangers with vertical-limit stops.
  - 4. Pipe riser resilient supports.
  - 5. Resilient pipe guides.
  - 6. Restraining braces and cables.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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:
  - 1. Kinetics Noise Control.
  - 2. Vibration Mountings & Controls, Inc.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  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.
- C. Spring Hangers: 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. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- D. 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.
- E. 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.

### PART 3 - EXECUTION

#### 3.1 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
  1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

- C. 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.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- 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. 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.
- G. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- 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 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. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.

- D. Prepare test and inspection reports.

**3.3 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 spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

**3.4 HVAC VIBRATION-CONTROL AND RESTRAINT DEVICE SCHEDULE**

- A. Provide spring hangers for all suspended fan coil units, blower coil units, and energy recovery ventilators.
- B. Provide restrained spring isolators for air handling unit AHU-1.
- C. Provide vibration control devices for all other mechanical equipment that has a fan or pump in accordance with manufacturer's recommendations.

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. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.
  - 8. Painting.

**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. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules).
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

**2.2 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 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-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: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.



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: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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: 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: Yellow background with black lettering.

2.7 PAINTING

- A. Product Data: For each type of product, include preparation requirements and application instructions.
- B. Samples: For each type of paint system and color submit samples on rigid backing, 8 inches square.
- C. Field Conditions: Apply paints only when temperature of surfaces to be painted an ambient air temperatures are between 50 and 95 deg F. Do not apply paints in snow, rain, fog or mist, or when relative humidity exceeds 85%, at temperatures less than 5 deg F above the dew point, or to damp or wet surfaces.
- D. Materials used within each painting system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- E. Colors: Final color selection to be by Architect.

**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: Paint exposed piping in mechanical equipment rooms to correspond with the color in the label schedule below.
- B. 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.
- C. Pipe Label Color Schedule:
  - 1. Chilled-Water Piping:
    - a. Background Color: Blue.
    - b. Letter Color: White.
  - 2. Heating Water Piping:
    - a. Background Color: Red.
    - b. Letter Color: White.

**3.4 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts.

- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; 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 with 2 inch round tags with natural color.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 EXTERIOR PAINTING SCHEDULE

- A. Stainless-Steel Outdoor Exposed Ductwork Jacketing:
  - 1. Latex System:
    - a. Prime Coat: Primer, bonding, solvent based.
    - b. Intermediate Coat: Latex, exterior, matching topcoat.
    - c. Topcoat: Latex, exterior, flat.
- B. Paint new vertical outdoor exposed ductwork connected to the side of Gymnasium Building #29.
- C. Intermediate and Topcoat Color: Black.

END OF SECTION 230553

**SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Variable-flow hydronic systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. 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 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- 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 used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
  - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- 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."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.

- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
  1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.



3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  - 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  - 3. Set terminal units at full-airflow condition.
  - 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  - 5. Adjust terminal units for minimum airflow.
  - 6. Measure static pressure at the sensor.
  - 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  - 1. Open all manual valves for maximum flow.
  - 2. Check liquid level in expansion tank.
  - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  - 6. Set system controls so automatic valves are wide open to heat exchangers.
  - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

**3.8 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.

**3.9 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each water coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.
  - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Airflow.
  - 3. Air pressure drop.
- D. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.

**3.10 PROCEDURES FOR BOILERS**

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

**3.11 TOLERANCES**

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

**3.12 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.

**3.13 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.
- 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 contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
  - 15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
  - D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
    - 1. Quantities of outdoor, supply, return, and exhaust airflows.
    - 2. Water 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.
- 3.14 ADDITIONAL TESTS
- A. 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 230713 - DUCT 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 duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, exposed supply and return.
- B. Related Sections:
  - 1. Section 230719 "HVAC Piping Insulation."
  - 2. Section 233113 "Metal Ducts" for duct liners.

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 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

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.

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### 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.

### 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 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. 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 without factory-applied jacket.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Owens Corning; Fiberglas 700 Series.
- E. 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. 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).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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1. 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: Water based; suitable for indoor use on below ambient services.

### 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  3. Service Temperature Range: 0 to plus 180 deg F.
  4. Color: White.

### 2.5 SEALANTS

- A. Metal Jacket Flashing Sealants:
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - c. 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.
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
  1. 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).

### 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

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1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

### 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers 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. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    - a. Factory cut and rolled to size.
    - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

### 2.8 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, available products that may be incorporated into the Work include, but are not limited to, 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, available products that may be incorporated into the Work include, but are not limited to, 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.

## 2.9 SECUREMENTS

### A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 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 thick, 1/2 inch wide with wing 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.

## 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.

### 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. 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.

### 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 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.
  - 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.
  - 1. Comply with requirements in Section 078413 "Penetration 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.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- 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, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive is not required on the top of the ductwork.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over-compress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- 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, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not over-compress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below."
  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.

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- B. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint stainless-steel jackets.

### 3.8 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.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Flexible connectors.
  - 5. Vibration-control devices.
  - 6. Factory-insulated access panels and doors.

### 3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed supply, return, exhaust, or outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and provide a thermal resistance value of at least R-4.
- B. Exposed, supply, return, exhaust, or outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and provide a thermal resistance value of at least R-4.

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### 3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Supply and return-air duct insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and provide a thermal resistance value of at least R-6.

### 3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums:
  - 1. Stainless Steel, Type 304 or Type 316, Corrugated: 0.020 inch thick.

END OF SECTION 230713



**SECTION 230716 - HVAC EQUIPMENT 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 HVAC equipment that is not factory insulated:
  - 1. Heating hot-water pumps.
  - 2. Air separators.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."

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 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 removable insulation at equipment connections.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

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. 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.

#### 1.6 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 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- B. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Block Insulation: ASTM C 552, Type I.
  2. Special-Shaped Insulation: ASTM C 552, Type III.
  3. Board Insulation: ASTM C 552, Type IV.
  4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- 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 I.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [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. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [CertainTeed Corp.; CertaPro 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. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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.](#)
- 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  1. 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. 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 and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. 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: Water based; suitable for indoor and outdoor use on below ambient services.

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### 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

### 2.5 SEALANTS

#### A. Joint Sealants:

1. [Joint Sealants for Cellular-Glass](#), Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Childers 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; 30-45.
  - d. [Mon-Eco Industries, Inc.](#); 44-05.
  - e. [Pittsburgh Corning Corporation](#); Pittseal 444.

#### B. ASJ Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. 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).

### 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

### 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

## 2.8 SECUREMENTS

### A. Bands:

1. 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.

### 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- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
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.

### C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

### D. Wire: 0.062-inch soft-annealed, stainless steel.

## 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 and equipment 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. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

**3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.
- O. 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 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.



- b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
  - d. Do not overcompress insulation during installation.
  - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
  - f. Impale insulation over anchor pins and attach speed washers.
  - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from stainless steel, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.5 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.

**3.6 FINISHES**

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below."

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 Engineer. Vary first and second coats to allow visual inspection of the completed Work.

**3.7 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.

**3.8 EQUIPMENT INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

- B. Insulate indoor and outdoor equipment that is not factory insulated.

END OF SECTION 230716

**SECTION 230719 - HVAC 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 HVAC piping systems:
  - 1. Heating hot-water piping, indoors.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."

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 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, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing 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.

1.6 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 Section 230529 "Hangers and Supports for HVAC 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, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. 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. 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 and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. 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: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  3. Service Temperature Range: 0 to plus 180 deg F.
  4. Color: White.

## 2.5 SEALANTS

- A. Joint Sealants:
1. 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. Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- C. ASJ Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: White.
  5. 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).

## 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

**2.7 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    - a. Factory cut and rolled to size.
    - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

**2.8 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

**2.9 SECUREMENTS**

- A. Bands:
  - 1. 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.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

**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.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. 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 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 4 inches 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. 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 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.
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 Section 078413 "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 Section 078413 "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

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.

**3.8 FIELD-APPLIED JACKET INSTALLATION**

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

**3.9 FINISHES**

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.
  - 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.

**3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. 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 a single location of straight pipe. .
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

**3.11 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Underground piping.

**3.12 INDOOR PIPING INSULATION SCHEDULE**

- A. Condensate and Equipment Drain Water below 60 Deg F:

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1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
    1. NPS 12 and Smaller: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
- 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Exposed:
    1. Stainless Steel, Type 304 or 316, Corrugated with Z-Shaped Locking Seam: 0.020 inch thick.

END OF SECTION 230719

**SECTION 230900 - INSTRUMENTATION AND CONTROL 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. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
  - 1. Section 230519 "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
- C. General: The existing control system consists of a high-speed, peer-to-peer network of DDC controllers, a control system server, and an operator workstation.
- D. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a web browser over the control system network, the Owner's local area network, and remotely over the Internet (through the Owner's LAN).
- E. The intent of the thin-client architecture is to provide operators complete access to the control system via a web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five 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: Report values and maintain measured variables within tolerances as follows:
  - a. Water Temperature: Plus or minus 1 deg F.
  - b. Water Flow: Plus or minus 5 percent of full scale.
  - c. Water Pressure: Plus or minus 2 percent of full scale.
  - d. Space Temperature: Plus or minus 1 deg F.
  - e. Ducted Air Temperature: Plus or minus 1 deg F.
  - f. Outside Air Temperature: Plus or minus 2 deg F.
  - g. Dew Point Temperature: Plus or minus 3 deg F.
  - h. Temperature Differential: Plus or minus 0.25 deg F.
  - i. Relative Humidity: Plus or minus 5 percent.
  - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
  - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
  - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
  - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
  - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
  - o. Carbon Dioxide: Plus or minus 50 ppm.
  - p. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

- A. Refer to the drawings for the Sequence of Operation.

1.6 ACTION SUBMITTALS

- A. 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.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.



2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  3. 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.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  3. Wiring Diagrams: Power, signal, and control wiring.
  4. Details of control panel faces, including controls, instruments, and labeling.
  5. Written description of sequence of operation.
  6. Schedule of dampers including size, leakage, and flow characteristics.
  7. Schedule of valves including flow characteristics.
  8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
  10. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
    - d. Points list.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
  - B. Qualification Data: For Installer and manufacturer.
  - C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
  - D. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 5. Calibration records and list of set points.
- B. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for DDC workstations and control systems.

1.9 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. Replacement Materials: One replacement diaphragm or relay mechanism for each unique valve motor controller thermostat.
  - 2. Maintenance Materials: One thermostat adjusting key(s).

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.11 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 equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.12 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- D. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

- A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An existing operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- B. The graphical user interface shall show the floor plans of each building with a standard color coding indicating zone temperature out of tolerance from set-point. This shall be intended to provide at a quick glance a complete overview of how the individual space systems are operating.
- C. With a single click from the main screen, the details of that zone air handling system shall be depicted.
- D. Other links from the home screen shall be able to have a single click and depict the details of the building hot water systems, rooftop units, variable volume air handling units, and exhaust fans.
- E. Controls system programming tools and associated hardware must be provided to the College. This should include any software and hardware required to maintain and program the controls system. Typically, this would include Niagara AX modules, programming software, configuration files, and connector cables. If software requires license, license must be provided for a minimum of 2 years from date of turnover.
- F. Unless building has LON or proprietary system, all new controls are to be native BACnet.
- G. The Controls Contractor shall replace or modify the existing local network controller if required, to accommodate additional controls points.

2.2 MANUFACTURERS

- A. The existing campus-wide control system is Honeywell AX currently serviced by Automated Building Controls, Inc. 732-918-8958. [DGolden@automatedbuilding.com](mailto:DGolden@automatedbuilding.com).
- B. The existing Honeywell AX control system overlays systems of various manufacturers. Each building may be equipped with a local network controller by any of the following manufacturers:
  - 1. Trane
  - 2. Honeywell
  - 3. Carrier
  - 4. Siemens
- C. The Controls Contractor shall be listed on the Honeywell Contractor website as BCS level or higher. The following are acceptable:
  - 1. Automated Building Controls, Inc. [dgolden@automatedbuilding.com](mailto:dgolden@automatedbuilding.com)
  - 2. AME Inc. [amit@ame-inc.com](mailto:amit@ame-inc.com)
  - 3. KF Mechanical [sales@kfmechanical.com](mailto:sales@kfmechanical.com)

2.3 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  - 3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Hot Water System Control Programs: Control function of hot-water control valve, and equipment sequencing.
    - d. Chilled Water System Control Programs: Control function of chilled-water control valve, and equipment sequencing.
    - e. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - f. Remote communications.
    - g. Maintenance management.

- h. Units of Measure: Inch-pound and SI (metric).
  - 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  - 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
- 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
  - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  - 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
- 1. Binary Inputs: Allow monitoring of on-off signals without external power.
  - 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  - 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  - 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
  - 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
  - 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  - 7. Universal I/Os: Provide software selectable binary or analog outputs.
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
- 1. Output ripple of 5.0 mV maximum peak to peak.
  - 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  - 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
- 1. Minimum dielectric strength of 1000 V.
  - 2. Maximum response time of 10 nanoseconds.
  - 3. Minimum transverse-mode noise attenuation of 65 dB.

4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
  1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
  3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
  4. Enclosure: Appropriate for installation application.
- B. Control valves.
  1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
  2. Valve actuator closing time shall be a minimum of 60 seconds.
  3. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
  4. Water Valves:
    - a. Two-way: 150% of total system (pump) head.
    - b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
  5. Water Valves:
    - a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
    - b. Sizing Criteria:
      - 1) Two-position service: Line size.
      - 2) Two-way modulating service: Pressure drop shall be equal to 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
      - 3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
      - 4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
      - 5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
  6. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
    - a. Water zone valves—normally open preferred.
    - b. Heating coils in air handlers—normally open.
    - c. Chilled water control valves—normally closed.
    - d. Other applications—as scheduled or as required by sequences of operation.
- C. Binary Temperature Devices

1. Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.
- D. Temperature sensors.
1. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
  2. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m<sup>2</sup> (10 ft<sup>2</sup>) of duct cross section.
  3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
  4. Space sensors shall be equipped with set point adjustment, override switch, display, and/or communication port as shown.
  5. Provide matched temperature sensors for differential temperature measurement.
- E. Humidity sensors.
1. Duct and room sensors shall have a sensing range of 20% to 80%.
  2. Duct sensors shall be provided with a sampling chamber.
  3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of □40°C to 75°C (□40°F to 170°F).
  4. Humidity sensor's drift shall not exceed 1% of full scale per year.
- F. Flow switches.
1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
  2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum) and shall have adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.
  3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as specified.
- G. Relays.
1. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
  2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- H. Current switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.
- I. Pressure transducers.
1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
  2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
  3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
  4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

- J. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
- K. Local control panels.
  - 1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
  - 2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
  - 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

## 2.5 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

### 3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 44 inches above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
  - 1. Entrances.
  - 2. Public areas.
  - 3. Where indicated.
- E. Install automatic dampers according to Section 233300 "Air Duct Accessories."



- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."
- I. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

### 3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.4 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.

3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
  - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
  - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
  - c. Verify that spare I/O capacity has been provided.
  - d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
  - a. Check analog inputs at 0, 50, and 100 percent of span.
  - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
  - c. Check digital inputs using jumper wire.
  - d. Check digital outputs using ohmmeter to test for contact making or breaking.
  - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:

- a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
  - b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
- a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
  - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
- a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
  - b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- 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 three visits to Project during other than normal occupancy hours for this purpose.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230900

**SECTION 231123 - FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.

1.3 DEFINITIONS

- A. 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.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Pipe, fittings and piping specialties.
  - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 3. Pressure regulators. Indicate pressure ratings and capacities.

4. 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. Shop Drawing Scale: 1/4 inch per foot.

#### 1.6 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.

#### 1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

#### 1.8 QUALITY ASSURANCE

A. Steel Support 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.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

#### 1.10 PROJECT CONDITIONS

A. 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 according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than three days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's and Owner's written permission.

**PART 2 - PRODUCTS**

**2.1 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black and galvanized 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 A 234/A 234M 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. Mechanical Couplings:
    - a. Stainless-steel flanges and tube with epoxy finish.
    - b. Buna-nitrile seals.
    - c. Stainless-steel bolts, washers, and nuts.
    - d. Coupling shall 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 shall be factory equipped with anode.

**2.2 PIPING SPECIALTIES**

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  - 2. Operating-Pressure Rating: 0.5 psig.
  - 3. End Fittings: Zinc-coated steel.
  - 4. Threaded Ends: Comply with ASME B1.20.1.
  - 5. Maximum Length: 72 inches.
- B. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  - 4. CWP Rating: 125 psig.
- C. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

- E. Weatherproof Vent Cap: 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.

2.3 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.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "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 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
  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" shall be permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated brass.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall 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.
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall 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.
- F. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B 584.
  2. Plug: Bronze.
  3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Operator: Square head or lug type with tamperproof feature where indicated.
  5. Pressure Class: 125 psig.
  6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A 126, 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.
  8. Listing: Valves NPS 1 and smaller shall 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.



- H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
  - 1. Body: Cast iron, complying with ASTM A 126, 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.
  - 8. Listing: Valves NPS 1 and smaller shall 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.

## 2.5 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: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. 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: Nitrile rubber.
  - 5. Seal Plug: Ultraviolet-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: 5 psig.

## 2.6 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 minimum at 180 deg F.
    - 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 minimum at 180 deg F.
- 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.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

2.7 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 wide and 4 mils thick, continuously inscribed with a description 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 deep; colored yellow.

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 according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Comply with the International 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. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- 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 long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for 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 pre-sleeved containment tubing with vented adaptor fittings. Install a vent pipe from containment sleeve 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. 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 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 pressure regulator.
- 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."

### 3.4 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

### 3.5 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 according to 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. 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, then use wrench. Do not overtighten.

### 3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

### 3.7 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

### 3.9 PAINTING

A. Paint exposed, interior metal piping, valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
  - a. Prime Coat: Alkyd anticorrosive metal primer.

- b. Intermediate Coat: Interior latex matching topcoat.
      - c. Topcoat: Interior latex semigloss.
      - d. Color: Yellow.
    - 2. Alkyd System: MPI INT 5.1E.
      - a. Prime Coat: Alkyd anticorrosive metal primer.
      - b. Intermediate Coat: Interior alkyd matching topcoat.
      - c. Topcoat: Interior alkyd semigloss.
      - d. Color: Yellow.
  - B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.
- 3.10 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
  - B. Tests and Inspections:
    - 1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
  - C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
  - D. Prepare test and inspection reports.
- 3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 2.0 PSIG
- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
    - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - B. Aboveground, distribution piping shall be one of the following:
    - 1. Steel pipe with malleable-iron fittings and threaded joints.
    - 2. Steel pipe with wrought-steel fittings and welded joints.
- 3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
    - 1. One-piece, bronze ball valve with bronze trim.
    - 2. Two-piece, full-port, bronze ball valves with bronze trim.
    - 3. Bronze plug valve.
  - B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
    - 1. Two-piece, full-port, bronze ball valves with bronze trim.
    - 2. Bronze plug valve.
    - 3. Cast-iron, non-lubricated plug valve.

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- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
  
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall 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.
  
- E. Valves in branch piping for single appliance shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. 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. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Hot-water heating piping.
  - 2. Condensate-drain piping.
  - 3. Blowdown-drain piping.
  - 4. Air-vent piping.
- B. Related Sections include the following:
  - 1. Section 232123 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be appropriate for the pressures and temperatures utilized on this project.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Plastic pipe and fittings with solvent cement.
  - 2. Pressure-seal fittings.
  - 3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  - 4. Air control devices.
  - 5. Chemical treatment.
  - 6. Hydronic specialties.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of



the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
  - 1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
  - 2. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, pre-lubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- E. Copper or Bronze Pressure-Seal Fittings:
  - 1. Housing: Copper.
  - 2. O-Rings and Pipe Stops: EPDM.
  - 3. Tools: Manufacturer's special tools.
  - 4. Minimum 200-psig working-pressure rating at 250 deg F.
- F. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "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 Part 3 "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.

H. Grooved Mechanical-Joint Fittings and 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:
  - a. Victaulic Company.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Victaulic Company.
2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- 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, 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 D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. 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).
    - b. 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. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Jomar International Ltd.
    - b. McDonald, A. Y. Mfg. Co.
    - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 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. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.6 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing 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:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    - c. Taco.
  - 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.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing 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:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    - c. Taco.
  - 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.
- E. Diaphragm-Operated Safety 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:

- a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
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: 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.

## 2.7 AIR CONTROL 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:
1. Amtrol, Inc.
  2. Armstrong Pumps, Inc.
  3. Bell & Gossett Domestic Pump; a division of ITT Industries.
  4. Taco.
- B. Manual Air Vents:
1. Body: Bronze.
  2. Internal Parts: Nonferrous.
  3. Operator: Screwdriver or thumbscrew.
  4. Inlet Connection: NPS 1/2.
  5. Discharge Connection: NPS 1/8.
  6. CWP Rating: 150 psig.
  7. Maximum Operating Temperature: 225 deg F.
- C. Expansion Tanks:
1. Refer to drawings for specified model, manufacturer, and accessories.
- D. Air Separators:
1. Refer to drawings for specified model, manufacturer, and accessories.

## 2.8 HYDRONIC PIPING SPECIALTIES

- 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.

- B. Stainless-Steel Bellow, Flexible Connectors:
  - 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
  - 2. End Connections: Threaded or flanged to match equipment connected.
  - 3. Performance: Capable of 3/4-inch misalignment.
  - 4. CWP Rating: 150 psig.
  - 5. Maximum Operating Temperature: 250 deg F.
  
- C. Expansion fittings are specified in Section 230516 "Expansion Fittings and Loops for HVAC Piping."

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
  
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of 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.
  - 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
  
- C. Hot-water heating piping installed belowground and within slabs shall be the following:
  - 1. Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
  
- D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
  
- E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
  
- F. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
  - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
  
- G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

**3.2 VALVE APPLICATIONS**

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

**3.3 PIPING INSTALLATIONS**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. 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 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 strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 230516 "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Section 230553 "Identification for HVAC Piping and Equipment."
- 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."

### 3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. 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. Spring hangers to support vertical runs.
- C. Install hangers for as indicated in details on the drawings.
- D. 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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. 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. PVC Nonpressure Piping: Join according to ASTM D 2855.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install air separator based on manufacturer's installation instructions.
- D. Install expansion tanks based on manufacturer's installation instructions.

### 3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

**3.8 FIELD QUALITY CONTROL**

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 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 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, to specified values.
  - 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

**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. Centrifugal pumps.

**1.3 DEFINITIONS**

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

**1.4 ACTION 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.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

**1.6 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. Mechanical Seals: One mechanical seal(s) for each pump.

**PART 2 - PRODUCTS**

**2.1 CENTRIFUGAL PUMPS**

- A. Refer to drawings for product performance data and Basis of Design.

**2.2 PUMP SPECIALTY FITTINGS**

- A. Suction Diffuser (if required):
  - 1. Angle pattern.
  - 2. Bronze startup and bronze or stainless-steel permanent strainers.
  - 3. Bronze or stainless-steel straightening vanes.
  - 4. Drain plug.
  - 5. Factory-fabricated support.

**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. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- C. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
  - 1. 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 nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### 3.4 CONNECTIONS

- A. 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 check, shutoff, and throttling valves on discharge side of pumps.
- F. Install Y-type strainer or suction diffuser 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 checks 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 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.

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5. Prime pump by opening suction valves and closing drains, and prepare 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 233113 - METAL DUCTS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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 shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."

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, 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, 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 for selecting hangers and supports.

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. 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.

B. Welding certificates.

PART 2 - PRODUCTS

2.1 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 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.
- 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 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."
- 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: G60.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. 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.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 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. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  - 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 C 916.
    - a. 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).
    - b. 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."
- B. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

## 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] [4 inches] [6 inches].
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  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, 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 and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. 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, "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.

**PART 3 - EXECUTION**

**3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. All medium pressure ductwork mains (upstream of VAV boxes) shall have acoustic duct lining.
- J. Provide a minimum of 10'-0" of acoustic lining downstream of all air handling equipment, fan coil units, and air terminal units (fan-powered and VAV boxes).
- K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- L. 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.
- M. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- N. 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 for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 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 thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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 of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

**3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

**3.6 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 Section 233300 "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.

3.7 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel, unless indicated otherwise on drawings.
- B. Ductwork running exposed in the Cafeteria/Gymnasium (Building #29) shall be fabric ductwork. Comply with requirements in Section 233716 "Fabric Air-Distribution Devices.
- C. Liner:
  1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick for fifteen feet from air handling unit connection.
  2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick for fifteen feet from air handling unit connection.
  3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick for fifteen feet from air handling unit connection.
  4. Transfer Ducts: Fibrous glass, Type I, 1 inch thick for all transfer ductwork.

END OF SECTION 233113

**SECTION 233300 - AIR DUCT ACCESSORIES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Backdraft dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Flange connectors.
  - 5. Turning vanes.
  - 6. Duct-mounted access doors.
  - 7. Flexible connectors.
  - 8. Flexible ducts.
  - 9. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Source quality-control reports

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

**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. 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.
- C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Pottorff.
  - 4. Ruskin Company.
- B. Description: Gravity balanced.

**2.4 MANUAL VOLUME DAMPERS**

- A. Standard, Steel, Manual Volume Dampers:
  - 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. Air Balance Inc.; a division of Mestek, Inc.

- b. American Warming and Ventilating; a division of Mestek, Inc.
  - c. Flexmaster U.S.A., Inc.
  - d. McGill AirFlow LLC.
  - e. Nailor Industries Inc.
  - f. Pottorff.
  - g. Ruskin Company.
  - h. Trox USA Inc.
  - i. Vent Products Company, Inc
2. Standard leakage rating, with linkage outside airstream.
  3. Suitable for horizontal or vertical applications.
  4. Provide 1" handle offset and end bearings.

## 2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Greenheck Fan Corporation.
  2. McGill AirFlow LLC.
  3. Nailor Industries Inc.
  4. Ruskin Company.
  5. Young Regulator Company

## 2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc
- B. Description: 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.

## 2.7 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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.

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1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. 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."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

### 2.8 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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."

### 2.9 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 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 steel.
- D. Fasteners: Carbon 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.

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### 2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ductmate Industries, Inc.
  - 2. Ventfabrics, Inc.
  - 3. 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 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.

### 2.11 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-value: R-4.
- C. 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.

2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install 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 and terminal units.
  - 2. Upstream 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. At each change in direction and at maximum 50-foot spacing.
  - 7. Upstream and downstream from turning vanes.
  - 8. Upstream or downstream from duct silencers.
  - 9. Control devices requiring inspection.
  - 10. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. 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.
- J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- M. Connect flexible ducts to metal ducts with draw bands.
- N. Install duct test holes where required for testing and balancing purposes.
- O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire 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.

END OF SECTION 233300



**SECTION 233600 - AIR TERMINAL UNITS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Single-duct air terminal units.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Field quality-control reports.
- E. Operation and maintenance data.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

**PART 2 - PRODUCTS**

**2.1 SINGLE-DUCT AIR TERMINAL UNITS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Environmental Technologies, Inc.
  - 2. Nailor Industries Inc.
  - 3. Price Industries.

4. Titus.
5. Trane; a business of American Standard Companies.

- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Refer to the drawings for sizes, performance, and the Basis of Design for standard features, options, and accessories.

## 2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

## 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
  1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted temperature sensors.

### 3.2 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 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 thick.

- 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.

### 3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

### 3.4 IDENTIFICATION

- A. 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.

### 3.5 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. Tests and Inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. 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.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.

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4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

### 3.7 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 - DIFFUSERS, REGISTERS, AND GRILLES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:

- 1. Diffusers
- 2. Registers
- 3. Grilles

- B. Related Sections:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated, include the following:

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
- 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

**PART 2 - PRODUCTS**

**2.1 DIFFUSERS, REGISTERS, AND GRILLES**

- A. Refer to drawings for performance and Basis of Design.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

**SECTION 235216 - CONDENSING BOILERS**

**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 packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Source quality-control test reports.
- B. Field quality-control test reports.
- C. Warranty: Special warranty specified in this Section.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

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- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

### 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Condensing Boilers:
    - a. Leakage and Materials: 10 years from date of Substantial Completion.
    - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. AERCO International.
  - 2. Heat Transfer Products, Inc.
  - 3. Lochinvar.

### 2.2 CONDENSING BOILERS

- A. Refer to drawings for performance and Basis of Design.

### 2.3 TRIM

- A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."
- B. Aquastat Controllers: Operating, firing rate, and high limit.
- C. Safety Relief Valve: ASME rated.



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- D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- E. Boiler Air Vent: Automatic.
- F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

### 2.4 CONTROLS

- A. Boiler operating controls shall include the following devices and features:
  - 1. Control transformer.
  - 2. Set-Point Adjust: Set points shall be adjustable.
  - 3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature as indicated on the drawings.
    - 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.
- B. 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.
- C. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
  - 1. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

### 2.5 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are 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.

2.6 SOURCE QUALITY CONTROL

- A. 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.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
  - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Equipment Mounting: Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches high and extend base not less than 6 inches in all directions beyond the maximum dimensions of boiler.
  - 3. Minimum Compressive Strength: 4000 psi at 28 days.
  - 4. 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.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 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.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. 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 232113 "Hydronic Piping."
- E. 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.
- F. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- I. Boiler Venting:
  - 1. Install flue venting and combustion-air intake.
  - 2. Connect full size to boiler connections. Comply with requirements in Section 235100 "Breechings, Chimneys, and Stacks."
- 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."

**3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform installation and startup checks according to 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.

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- 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.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. 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.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235216

**SECTION 237413 – OUTDOOR CENTRAL AIR HANDLING UNITS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Hot water heating coil.
  - 2. Condenser section.
  - 3. Economizer outdoor- and return-air damper section.
  - 4. Power exhaust section
  - 5. Space temperature controls (if applicable).
  - 6. Roof curbs.

1.2 DEFINITIONS

- A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- B. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- C. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- D. VVT: Variable-air volume and temperature.

1.3 PERFORMANCE REQUIREMENTS

- A. Refer to schedules on mechanical drawings for equipment basis of design performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

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### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### 1.7 QUALITY ASSURANCE

- A. ARI Compliance:
  - 1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
  - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. 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. Installing contractor will coordinate the following items with applicable trades:
  - 1. Structural supports for units.
  - 2. Location of roof curbs, unit supports and roof penetrations.
  - 3. Ductwork sizes and connection locations.
  - 4. Piping size and connection/header locations.
  - 5. Interference with existing or planned ductwork, piping and wiring.
  - 6. Electrical power requirements and wire/conduit and over current protection sizes.
  - 7. Trap height requirements.

### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. AAON.
  - 2. Trane.
  - 3. YORK; a Johnson Controls company.

**2.2 CASING**

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Solution unit is specifically designed for outdoor application.
- C. Unit casing will consist of a structural frame with insulated roof, wall, and floor panels.
- D. Removal of wall panels will not affect structural integrity of units.
- E. Unit casing will be insulated with spray injected foam to achieve thermal resistance of R-13 hr-ft<sup>2</sup>-°F/BTU. Insulation application will meet the requirements of NFPA 90A.
- F. Unit will conform to ASHRAE Standard 111 Class 6 for casing leakage no more than 1% of design airflow at 1.25 times design static pressure up to a maximum of +8 inches w.g. in positive pressure sections and -8 inches w.g. in negative pressure sections.
- G. Unit will have double wall, 2" insulated panels for walls, roof, and floor. Exterior skin will be galvanized and painted sheet steel. Individual segments will have galvanized sheet steel, stainless sheet steel, or perforated galvanized interior liner, as described in performance specifications.
- H. Double wall access doors will be provided on sections as shown on product drawings.
  - 1. Stainless steel hinges permit a 180° door swing.
  - 2. Access door will be of the same material type as exterior/interior casing.
  - 3. Access door latches will use a roller cam latching mechanism.
- I. Primary and auxiliary drain pans will comply with the guidelines of ASHRAE 62.
  - 1. Drain pans will be double sloped at least 1/8" per foot, and have no horizontal surfaces.
  - 2. Drain connection material will be the same as drain pan.
  - 3. Drain pans will drain to one point.
  - 4. Drain connections will be welded to drain pans.
  - 5. Drain pans will have at least 1" clearance between pan and coil supports.

**2.3 FANS**

- A. Fans will provide CFM and static pressure, as shown in performance specifications.

- B. Fans will be Class I, II, or III, as required to meet selected RPM and horsepower shown in performance specifications.
- C. Fans will be DWDI (housed) or SWSI (plenum), as shown on product drawings.
- D. Fans will have forward curved or airfoil blades, as shown in performance specifications.
- E. Airfoil fans will bear the AMCA Seal. Airfoil fan performance will be based on tests in accordance with AMCA standard 210 and will comply with the requirements of AMCA certified ratings programs for air and sound. Airfoil wheels will comply with AMCA standards 99-2408-69 and 99-2401-82.
- F. Fans shafts will be polished steel and sized such that the first critical speed will be at least 125% of the maximum operating speed for the fan pressure class. Shaft will be coated with an anti-corrosion coating.
- G. Fan and motor assembly will be internally mounted on a common base. Fan and motor base will be spring isolated on a full width isolator support channel.
  - 1. Fan motor will be on an adjustable base.
  - 2. Fan discharge will be connected to cabinet via a flexible connection.
  - 3. Access doors will be provided as shown on product drawing.
- H. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

#### 2.4 HOT WATER HEATING COIL

- A. Description: Factory installed hot water heating coil located upstream of the supply fan section. Coil shall be stubbed in the side access section. Hot water piping connections will be thru the unit floor.
- B. Hot water coil shall be provided with Galvanized casing, .016 Copper fins and .006 aluminum fin thickness. Hot water control valve shall ship loose for field installation by others.
- C. Control wiring to the control valve shall be in the field by others.

#### 2.5 CONDENSER SECTION

- A. Condenser Fans – Condenser fans shall be matched up with compressors to optimize system control. Condenser fans shall be propeller type with aluminum blades, directly driven by permanently lubricated open drip-proof type (ODP) motor.
- B. Condenser Coil – Microchannel condenser coils shall be constructed of parallel flow aluminum alloy tubes metallurgically brazed to enhanced aluminum alloy fins. Condenser cleaning hatches shall be provided for access to condenser coil without the removal of condenser fans.
- C. Sight Glasses shall be accessible without having to open air handler section access doors or remove panels.
- D. Fixed Speed Compressors – Units shall use hermetic scroll compressors, piped and charged with oil and R-410A refrigerant. Each compressor shall be protected from over-temperature and over-current conditions. Compressors shall be vibration-isolated from the unit, and



installed in an easily accessible area of the unit. All compressor-to-pipe connections shall be brazed to minimize potential for leaks.

- E. Variable Speed Drive Compressors – Units shall use variable speed drive scroll compressor, piped and charged with oil and R410A refrigerant. Units shall have a minimum capacity of 15% of full load. Each compressor shall be protected from over-temperature and over-current conditions. Compressors shall be vibration-isolated from the unit, and installed in an easily accessible area of the unit. All compressor-to-pipe connections shall be brazed to minimize potential for leaks. Variable speed drive scroll compressors shall be matched and factory tested with VFD. All high efficiency units shall meet 2019 CEE Highest Tier efficiency ratings.
- F. In-Line Refrigerant Filter Driers – Liquid line filter driers shall be provided as a standard on the unit.
- G. Condenser Enclosure – The condenser section shall be enclosed by a wire grill condenser enclosure on the three exposed sides.
- H. Condenser Safety tie-off shall be supplied on condenser roof. Safety tie-off shall allow for service technician to attach personal fall protection device during repair/inspection of condenser fan and motors.

## 2.6 DAMPERS

- A. Dampers will be factory installed.
- B. Dampers will have airfoil blades with extruded vinyl edge seals and flexible metal compressible jamb seals.
- C. Dampers will have a maximum leakage rate of 4 CFM/square foot at 1" w.g. and comply with ASHRAE 90.1.
- D. Maximum damper torque requirement will be 7 in. lbs./ft<sup>2</sup>.
- E. Damper blades will be parallel acting unless submitted otherwise.
- F. Damper blades will be galvanized steel or aluminum.

## 2.7 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- B. Provide 120 VAC LED lights in each access section.
- C. Provide powered GFI outlet and light switch adjacent to the supply fan access door.
- D. Unit mounted prewired convenience outlet

## 2.8 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and on the drawings.

2.9 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Smoke detector where required by code.

2.10 ROOF CURBS

- A. Roof curbs will be furnished, as shown on product drawings.
- B. Roof curbs will be galvanized steel and support the perimeter of units, including pipe chases.
- C. Roof curbs will have a wood nailing strip.
- D. Roof curbs will be shipped loose for installation prior to unit installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration Controls for HVAC."
- B. Roof Curb: Install RTUs on roof curb provided by manufacturer and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories."
- C. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain.

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. Report results in writing.
- B. Tests and Inspections:
  - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 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.

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- C. Remove and replace malfunctioning units and retest as specified above.

### 3.3 CLEANING AND ADJUSTING

- A. 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 site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

END OF SECTION 237413

**SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

**1.2 REFERENCES**

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
  - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

**1.3 SYSTEM DESCRIPTION**

- A. Product Requirements: Provide products as follows:
  - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
  - 2. Stranded conductors for control circuits.
  - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
  - 4. Conductor not smaller than 16 AWG for control circuits.
  - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
  - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable.
  - 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
  - 3. Above Accessible Ceilings: Use only armored cable or metal clad cable.
  - 4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
  - 5. Exterior Locations, including Underground (except services): Use only building wire, Type THHN/THWN insulation, in raceway.
  - 6. Exterior Services: Use only building wire, Type XHHW insulation, in raceway.

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7. Indoor Cable Tray Locations: Use only Tray cable Type TC.
8. Outdoor Cable Tray Locations: Use NEC approved unless otherwise specified.

### 1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop.

### 1.5 SUBMITTALS

- A. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- B. Test Reports: Indicate procedures and values obtained.

### 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and circuits.

### 1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15 and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Maintain one copy of each document on site.

### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

### 1.10 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned.

**PART 2 PRODUCTS**

**2.1 BUILDING WIRE**

- A. Manufacturers:
  - 1. Rome Cable.
  - 2. Southwire
  - 3. Superior Essex
  - 4. Or Approved Equal
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 75 degrees C unless otherwise specified or required by NEC.

**2.2 METAL CLAD CABLE AND ARMORED CABLE**

- A. Manufacturers:
  - 1. Diamond Wire & Cable Co
  - 2. Essex Group Inc.
  - 3. General Cable Co
  - 4. Or Approved Equal
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75 degrees C unless otherwise specified or required by NEC.
- E. Armor Material: Steel unless otherwise specified.
- F. Armor Design: Interlocked metal tape.

**2.3 TRAY CABLE**

- A. Product Description: Multiconductor power and control cable NFPA 70 Type TC.
- B. Conductor: Copper.
- C. Insulation: Flame-retardant cross-linked polyethylene.
- D. Overall Jacket: Polyvinyl Chlorine (PVC) in accordance with UL 1277.
- E. Insulation Voltage Rating: 600 volts.
- F. Insulation Temperature Rating: 90 degrees C.

- G. Listings: Finished cable UL listed as Type TC, and sunlight resistant.

## 2.4 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. For interior work, verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable [, including abandoned wire and cable above accessible ceiling finishes]. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

### 3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated.

- D. Special Techniques--Building Wire in Raceway:
  - 1. Pull conductors into raceway at same time.
  - 2. Install building wire 4 AWG and larger with pulling equipment.
  
- E. Special Techniques - Cable:
  - 1. Protect exposed cable from damage.
  - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
  - 3. Use suitable cable fittings and connectors.
  
- F. Special Techniques - Wiring Connections:
  - 1. Clean conductor surfaces before installing lugs and connectors.
  - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
  - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
  - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
  - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
  - 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
  - 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
  
- G. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
  
- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
  
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
  
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

### 3.5 WIRE COLOR

- A. General:
  - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
    - a. Black and red for single phase circuits at 120/240 volts.
    - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
    - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
  - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:



- a. Black and red for single phase circuits at 120/240 volts.
  - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
  - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
1. For 6 AWG and smaller: Green.
  2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 260519

**SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Rod electrodes.
  - 2. Active electrodes.
  - 3. Wire.
  - 4. Grounding well components.
  - 5. Mechanical connectors.
  - 6. Exothermic connections.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
  - 1. Metal underground water pipe.
  - 2. Metal building frame.
  - 3. Concrete-encased electrode.
  - 4. Ground ring where shown on Drawings.
  - 5. Rod electrode.
  - 6. Plate electrode.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- C. Manufacturer's Installation Instructions: Submit for active electrodes.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing work of this section with minimum three years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

- A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

**PART 2 PRODUCTS**

**2.1 ROD ELECTRODES**

- A. Product Description:
  - 1. Material: Copper-clad steel or Copper.
  - 2. Diameter: 3/4 inch.
  - 3. Length: 10 feet.
- B. Connector: Connector for exothermic welded connection when buried. U-bolt clamp when exposed or inspectable after final construction.

**2.2 ACTIVE ELECTRODES**

- A. Product Description:
  - 1. Material: Metallic-salt-filled copper-tube electrode.
  - 2. Length: 10 feet or as specified.
  - 3. Connector: Connector for exothermic welded connection.

**2.3 WIRE**

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

**2.4 GROUNDING WELL COMPONENTS**

- A. Well Pipe: 8 inches NPS by 24 inches long clay tile or lightweight concrete.
- B. Well Cover: Fiberglass or lightweight concrete with legend "GROUND" embossed on cover.

**2.5 MECHANICAL CONNECTORS**

- A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

**2.6 EXOTHERMIC CONNECTIONS**

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

**3.2 PREPARATION**

- A. Remove paint, rust, mill oils and surface contaminants at connection points.

**3.3 EXISTING WORK**

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

**3.4 INSTALLATION**

- A. Install in accordance with IEEE 142 or IEEE 1100 as applicable.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding well pipe with cover at rod locations as indicated on Drawings or as directed. Install well pipe top flush with finished grade.
- E. Install 4 AWG bare copper wire in foundation footing.
- F. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond steel together.
- G. Where applicable, bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Install isolated grounding conductor for circuits supplying computers in accordance with IEEE 1100.
- I. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.
- J. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- K. Connect to site grounding system.
- L. Bond to lightning protection system as applicable.

- M. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- N. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- O. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- P. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- Q. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- R. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform leakage current tests in accordance with NFPA 99.
- E. Perform continuity testing in accordance with IEEE 142.
- F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 260526

**SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:

- 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
- 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

- B. National Electrical Manufacturers Association:

- 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
- 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.5 SUBMITTALS

- A. Product Data: Submit for the following:
  - 1. Flexible metal conduit.
  - 2. Liquidtight flexible metal conduit.

3. Nonmetallic conduit.
4. Flexible nonmetallic conduit.
5. Nonmetallic tubing.
6. Raceway fittings.
7. Conduit bodies.
8. Surface raceway.
9. Wireway.
10. Pull and junction boxes.
11. Handholes.

- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
1. Record actual routing of conduits larger than 2 inch.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

#### 1.8 COORDINATION

- A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

### PART 2 PRODUCTS

#### 2.1 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.



**2.2 PVC COATED METAL CONDUIT**

- A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

**2.3 FLEXIBLE METAL CONDUIT**

- A. Product Description: Interlocked steel construction.
- B. Fittings: NEMA FB 1.

**2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT**

- A. Product Description: Interlocked steel construction with PVC jacket.
- B. Fittings: NEMA FB 1.

**2.5 ELECTRICAL METALLIC TUBING (EMT)**

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

**2.6 NONMETALLIC CONDUIT**

- A. Product Description: NEMA TC 2; Schedule 40 or 80 PVC as noted on the Drawings.
- B. Fittings and Conduit Bodies: NEMA TC 3.

**2.7 NONMETALLIC TUBING**

- A. Product Description: NEMA TC 2.
- B. Fittings and Conduit Bodies: NEMA TC 3.

**2.8 WIREWAY**

- A. Product Description: General purpose indoors, raintight outdoors type wireway.
- B. Knockouts: Manufacturer's standard.
- C. Cover: Screw cover.
- D. Connector: Slip-in.

- E. Finish: Rust inhibiting primer coating with gray enamel finish.

## 2.9 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
  - 2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- D. Wall Plates for Finished Areas: As specified on Drawings.
- E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

## 2.10 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 27 16.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
  - 1. Material: Cast aluminum.
  - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
  - 3. Cover Legend: "ELECTRIC" or as noted on Drawings.
- E. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
  - 1. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.
  - 2. Cover Legend: "ELECTRIC" or as noted on Drawings.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

**3.2 EXISTING WORK**

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

**3.3 INSTALLATION**

- A. Ground and bond raceway and boxes.
- B. Fasten raceway and box supports to structure and finishes.
- C. Identify raceway and boxes.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

**3.4 INSTALLATION - RACEWAY**

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional raceways.

- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs to fasten conduit to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes except where noted on Drawings. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

**3.5 INSTALLATION - BOXES**

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified on the Drawings.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

**3.6 INTERFACE WITH OTHER PRODUCTS**

- A. Install conduit to preserve fire resistance rating of partitions and other elements.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

**3.7 ADJUSTING**

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

**3.8 CLEANING**

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

**SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Labels.
  - 3. Wire markers.
  - 4. Conduit markers.
  - 5. Stencils.
  - 6. Underground Warning Tape.
  - 7. Lockout Devices.

1.2 SUBMITTALS

- A. Product Data:
  - 1. Submit manufacturer's catalog literature for each product required.
  - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- B. Samples:
  - 1. Submit two samples of each type of identification products applicable to project.
  - 2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NJDOT standard.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

### PART 2 PRODUCTS

#### 2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Letter Size:
  - 1. 1/8 inch high letters for identifying individual equipment and loads.
  - 2. 1/4 inch high letters for identifying grouped equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch.

#### 2.2 LABELS

- A. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

#### 2.3 WIRE MARKERS

- A. Description: Split sleeve, or tubing type wire markers.
- B. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings or as adjusted after balancing.
  - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams or shop drawings.



**2.4 CONDUIT AND RACEWAY MARKERS**

- A. Description: Labels fastened with adhesive.
- B. Color:
  - 1. Black lettering on white background.
- C. Legend:
  - 1. \_\_\_\_ VOLTS - HIGH VOLTAGE (add system voltage)

**2.5 STENCILS**

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
  - 2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.
- B. Stencil Paint: Semi-gloss enamel, colors conforming to the following:
  - 1. Black lettering on white background.
  - 2. White lettering on gray background.
  - 3. Red lettering on white background.
  - 4. Blue lettering on white background.

**2.6 UNDERGROUND WARNING TAPE**

- A. Description: 4 inch wide plastic tape, detectable type, colored [red or yellow with suitable warning legend describing buried electrical lines.

**2.7 LOCKOUT DEVICES**

- A. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

**PART 3 EXECUTION**

**3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as specified by Manufacturer for stencil painting.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates, labels and markers.
- D. Re-stencil existing equipment.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
  - 1. Install nameplate parallel to equipment lines.
  - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
  - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
  - 4. Secure nameplate to equipment front using adhesive.
  - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
  - 6. Install nameplates for the following:
    - a. Switchboards.
    - b. Panelboards.
    - c. Transformers.
    - d. Service Disconnects.
    - e. Control Equipment
    - f. Power Conversion Equipment
- C. Label Installation:
  - 1. Install label parallel to equipment lines.
  - 2. Install label for identification of individual control device stations
  - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
  - 1. Install wire marker for each conductor at gutters, pull boxes, outlet and junction boxes and each load connection.
  - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  - 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
- E. Raceway Marker Installation:
  - 1. Install raceway marker for each conduit or raceway longer than 6 feet.
  - 2. Raceway Marker Spacing: 20 feet on center.

- F.     Underground Warning Tape Installation:
  - 1.     Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 260553

**SECTION 262823 - ENCLOSED CIRCUIT BREAKERS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

1.02 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. Underwriters Laboratories Inc.:
  - 1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.03 SUBMITTALS

- A. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER

- A. Product Description: Enclosed, molded-case circuit breaker conforming to UL 489, suitable for use as service entrance equipment where applied.
- B. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time, short time and continuous current settings for automatic operation.

- C. Current Limiting Circuit Breaker: Circuit breaker indicated as current-limiting have automatically-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.
- D. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.
- E. Current Limiter: Designed for application with molded case circuit breaker.
  - 1. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
  - 2. Interlocks trip circuit breaker and prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.
- F. Accessories: As indicated on Drawings. Conform to UL 489.
- G. Enclosure: UL 489, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 3R.
  - 3. Industrial Locations: Type 4X.
- H. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

## 2.02 INSULATED CASE CIRCUIT BREAKER

- A. Product Description: Enclosed, insulated-case circuit breaker conforming to UL 489, suitable for use as service entrance equipment where applied.
- B. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- C. Accessories: As indicated on Drawings. Conform to UL 489.
- D. Enclosure: UL 489, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 3R.
  - 3. Industrial Locations: Type 4X.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

PART 3 - EXECUTION

3.01 EXISTING WORK

- A. Disconnect and remove abandoned enclosed circuit breakers.
- B. Maintain access to existing enclosed circuit breakers and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed circuit breakers to remain or to be reinstalled.

3.02 INSTALLATION

- A. Install enclosed circuit breakers plumb. Provide supports.
- B. Height: 5 feet to operating handle.
- C. Install grounding and bonding.
- D. Locate and install engraved plastic nameplates.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.04 ADJUSTING

- A. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 262823

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**End of Section**

## Section 28 00 00 – General Technology Requirements

### Part 1 - General

#### 1.01 Project Summary

- A. Scope: Successful bidder shall provide, install, configure, and provide warranty service for technology systems described herein.

#### 1.02 Related Documents

- A. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

#### 1.03 Related Work

- A. Section 28 05 00 – Physical Security General Requirements
- B. Section 28 10 00 – Electronic Access Control System
- C. Section 28 20 00 – Video Surveillance System

#### 1.04 Definitions

- A. Approved or Approval: Where approval is called for, only persons with the authorized authority may grant approval. Owner reserves all rights to govern over and grant approval and will appoint authority of agents acting on their behalf.
- B. As Required: Contractor shall provide the quantity of said item that is necessary. The Owner reserves the right to make the final determination of necessary quantities to provide for a complete system.
- C. Basis of Design: The documentation of the concepts, calculations, decisions, and product selections used to meet the Owner's project requirements. These Owner produced documents are not shop drawings. Product selections depict minimum functionality and overall quality and are open to substitution requests.
- D. Contractor: The qualified party responsible to provide all items and perform services as described within these documents. The Contractor referred to within a specific specification section shall be the successful qualified party contracted to perform and complete that work.
- E. Documents: The complete package of Bid and Contract Requirements, General Technology Requirements, related Division 27 sections, drawings, schedules, and addenda that make up this Request for Bid.
- F. End-User: Individual(s) who will ultimately operate the completed system.

- G. ETR: Existing to Remain. Item is to remain in current location and maintain current functionality.
- H. Furnish: To supply and deliver to project site, ready for installation.
- I. Install: To place in a position of service or use.
- J. NIC: Not in Contract. Item will be the responsibility of others.
- K. Notice to Proceed: Formal communication from Owner to Contractor stating the date the Contractor can begin work subject to the conditions of the contract. The performance time of the contract starts from the Notice to Proceed date.
- L. OFCI: Owner Furnished Contractor Installed. Item will be provided by Owner and shall be installed by Contractor.
- M. OFE: Owner Furnished Equipment. Item will be provided and integrated by Owner.
- N. OFOI: Owner Furnished Owner Installed. Item will be provided and installed by Owner.
- O. Owner: The party named in the Procurement and Contract Requirements as the advertising party.
- P. Provide: To furnish and install, complete and ready for intended use.
- Q. Substantial Completion: The stage in the progress of installation when the systems described herein are sufficiently complete, in accordance with the Contract Documents, so that the Owner can utilize such systems for their complete intended use.
- R. Turnkey: Of or involving the provision of a complete product or service that is ready for immediate use.
- S. Work: The provision of products and/or services to meet the requirements specified in these documents.

#### 1.05 Reference Standards and Codes

- A. Standards and other procedures referenced by this bid package are as follows:
  - 1. ADA – Americans with Disabilities Act of 2010  
[www.ada.gov/2010ADASTandards\\_index.htm](http://www.ada.gov/2010ADASTandards_index.htm)
  - 2. AIA – American Institute of Architects  
[www.aia.org](http://www.aia.org)
  - 3. ANSI – American National Standards Institute  
[www.ansi.org](http://www.ansi.org)

4. ASTM – American Society of Testing and Materials  
[www.astm.org](http://www.astm.org)
5. BICSI – Building Industry Consulting Service International, Inc.  
(RCDD Standards)  
[www.bicsi.org](http://www.bicsi.org)
6. CFR – Code of Federal Regulations  
[www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR](http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR)  
(Available from the Government Printing Office)  
(Material is usually first published in the Federal Register)
7. U.S. Copyright Law, December 2011  
[www.copyright.gov/title17](http://www.copyright.gov/title17)
8. ECIA – Electronic Components Industry Association  
ESC – EIA Standards Council  
[www.eciaonline.org](http://www.eciaonline.org)
9. IACS – International Annealed Copper Standard  
[www.ndt-ed.org/GeneralResources/IACS/IACS.htm](http://www.ndt-ed.org/GeneralResources/IACS/IACS.htm)
10. IEC – International Electrotechnical Commission  
[www.iec.ch](http://www.iec.ch)
11. IEEE – Institute of Electrical and Electronics Engineers  
[standards.ieee.org](http://standards.ieee.org)
12. ISO – International Organization for Standardization  
[www.iso.org](http://www.iso.org)
13. ITU-T – International Telecommunication Union – Telecommunication  
[www.itu.int](http://www.itu.int)
14. NEC – National Electrical Code (NFPA 70)  
maintained by NFPA – National Fire Protection Association  
[www.nfpa.org](http://www.nfpa.org)
15. NECA – National Electrical Contractors Association  
[www.necanet.org](http://www.necanet.org)
16. NEMA – National Electrical Manufacturers' Association  
[www.nema.org](http://www.nema.org)
17. OSHA – Occupational Safety and Health Administration  
(U.S. Department of Labor, OSHA)  
[www.osha.gov](http://www.osha.gov)
18. TIA – Telecommunications Industry Association  
[www.tiaonline.org/standards](http://www.tiaonline.org/standards)

## 19. UL – Underwriters’ Laboratories

[www.ul.com](http://www.ul.com)

- B. Standards: Referenced standards and/or procedures shall be binding on the Contractor and work shall be judged against such standards and procedures unless otherwise stated in writing.
- C. Local/State Codes: Contractor shall comply with all local and state code requirements as determined by the authority having jurisdiction (AHJ).
- D. Owner Standards: Contractor shall obtain and abide by all published Owner standards as they pertain to the work described herein.
- E. Contractor shall use the latest versions of all standards and codes unless otherwise directed by the authority having jurisdiction (AHJ) or expressly noted herein.

## 1.06 Qualifications

- A. Refer to related sections for specific requirements.

## 1.07 Permits and Inspections

- A. Responsibility: Obtain permits and inspections required for the work. Contractor is responsible for all permit and inspection costs.
- B. Performance: Perform tests required herein, or as may be reasonably required to demonstrate conformance with the specifications or with the requirements of any legal authority having jurisdiction.
- C. Review: Obtain approvals from authorities responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with all requirements of reference codes indicated herein and required by the appropriate jurisdiction. Make corrections, changes or additions as required and deliver certificates of acceptance, operation, and/or compliance with the Operation and Maintenance Manuals described herein.

## 1.08 Drawings and Basis of Design

- A. General: Work, equipment, or material delineated on any drawing in this package is expected to be provided by Contractor unless noted otherwise.
- B. Interpretation: Work shall be installed in accordance with the basis of design diagrammatically expressed on the drawings and described in the written specifications and equipment schedule(s). Contractor shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

### 1.09 Product Substitution Procedures

- A. Requests for Substitutions: Should the Contractor request a change in the material that is to be supplied, from that which was specified in the contract, the Contractor shall provide the Owner with a written request for said change.
- B. Substitutions for Non-specified Products: Where no product specification is provided, Contractor may use manufacturer's specification for the identified product as a guide for suggesting appropriate substitutions.
- C. Requirements: The Request for Substitution shall include:
  - 1. Reason for substitution.
  - 2. Material data sheets for both the proposed item(s) and the item(s) to be replaced.
  - 3. Any cost impact to the Owner.
- D. Changes: Proposed changes to Contract Documents shall be clearly identified in the pre-construction submittals.
- E. Approval: The Owner may approve or deny any Requests for Substitution. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specifications. The Contractor shall not procure any substitute materials until the Owner has approved and signed the Request for Substitution and passed copies to the Contractor and the Owner. Any procurement or work performed prior to this approval is at the Contractor's own risk.
- F. Deviation: Products provided or installed that deviate from the products specified in make, model, color, or other significant characteristic (i.e., non-approved substitutions) shall be removed and replaced with specified products at no additional expense to Owner.

### 1.10 Software

- A. Versions: The following software versions for this project:
  - 1. Autodesk AutoCAD MEP 2018

### 1.11 Submittal Conditions

- A. The Contractor shall not consider the Owner's review of submittals to be exhaustive or complete in every detail. Approval of shop drawings or submittals including substitutions indicates only the acceptance of the Contractor's apparent intent to comply with general design or method of construction and quality as specified. The finished product shall meet functional requirements, operations, arrangements, and quantities and comply with the contract documents unless specifically approved otherwise.



- B. The Contractor shall be held responsible for delivery of systems as specified. Any errors or omissions in the submittals shall not relieve Contractor of responsibility to deliver complete systems as specified.

#### 1.12 Pre-Construction Procedures

- A. Pre-Construction Submittal Meeting: Contractor shall schedule web conference (WebEx or similar) with Owner to review basis of design and submittal expectations.
- B. Prior to Work: Pre-construction submittals shall be provided to Owner with appropriate promptness as to cause no delay to the work.
- C. Project Timeline: Project timeline will not be altered due to lateness of submittals. Contractor is bound to deliver a timely, complete, and finished project as stipulated in their contract and specified herein.
- D. Format and Distribution: Contractor shall provide one (1) electronic copy in PDF format to Owner of all pre-construction submittals. The Contractor shall provide hard copies sets as required up to five (5) sets.
- E. Provision: Contractor shall submit pre-construction submittals including any corrections or additions to Owner prior to the procurement of equipment or commencement of work.
- F. Review: Pre-construction submittals shall be received and formally approved by Owner prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at Contractor's own risk.
- G. Failure to Provide: The failure of Contractor to provide pre-construction submittals as required herein may result in the withholding of payment for work and/or the cancellation of the contract.

#### 1.13 Pre-Construction Submittals

- A. Pre-construction submittals are intended to document the details of installation. Exact copies of original drawings and specifications are not acceptable as pre-construction submittal drawings. The schematic diagrams describe the basis of design as defined herein.
- B. Contractor shall provide to Owner the following pre-construction submittals for approval in addition to specific requirements identified in subsequent sections.
  - 1. Qualifications: Shall include documentation of all required qualifications.
  - 2. Shop Drawings:
    - a. Title: Each drawing shall have a descriptive title and all subparts of each drawing shall have unique identifiers.
    - b. Floor Plans: Shall include device locations, Contractor provided furniture and installation notes.

- c. System Drawings: Shall include functional diagrams for each system detailing system flow including all equipment, routing, inputs/outputs, wiring signal type, cable identification detail, connectors, adapters, intra/inter-rack power distribution, installation notes and any other information required to convey the complete turnkey system design.
  - d. Equipment Rack and Cabinet Elevations: Shall include placement of all mounted equipment.
  - e. Structurally Mounted Elements: Shall include both plan view of placement as well as a detail of structural mounting techniques to be used.
  - f. Furniture: Shall include all Contractor provided furniture showing dimensional drawings, cable management and finishes with samples for Owner approval.
3. Product Data:
- a. Equipment Schedules: Shall include manufacturers, part numbers, quantities and unit pricing.
  - b. Product Cut Sheets: Shall identify (highlight, arrow, etc.) actual part numbers to be utilized including but not limited to equipment, mounting hardware, cabling, connectors, software and power distribution equipment.
4. Manufacturer's Recommendations:
- a. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, copies of these recommendations shall be provided prior to installation. Installation of the items will not be allowed to proceed until the recommendations are received and approved.

#### 1.14 Construction Progress Procedures

- A. Meeting Attendance: Contractor is required to attend job progress meetings in accordance with requirements set by Owner. This will consist of a weekly WebEx/Conference call.
- B. Additional Coordination: Contractor shall request additional job construction coordination meetings it deems to be necessary to ensure coordination of their responsibilities with other parties.
- C. Progress Inspection: Owner may perform periodic progress inspections. At Owner's request, Contractor shall make Project Manager and/or Lead Technician available.
- D. Test Plan: Ten (10) business days prior to the proposed Contractor test date, Contractor shall provide a test plan defining the tests required.
  - 1. The test plan shall be approved by Owner prior to any testing.

### 1.15 Construction Progress Submittals

- A. Completion: Contractor shall complete and submit via email all construction progress documentation in PDF format as requested by Owner.
- B. Contractor shall provide to Owner the following construction progress submittals in addition to specific requirements identified in subsequent sections.
  - 1. Weekly Report: Weekly written report to be submitted to Owner through appropriate project channels in PDF format outlining progress from previous week, plans for progress in the current week, and any coordination issues that may require Owner attention.
  - 2. Test Plan: Shall ensure the system meets Owner operational and performance specifications and include the following:
    - a. Identification of the capabilities and functions to be tested.
    - b. Detailed instructions for the setup and execution of each test.
    - c. Procedures for evaluation and documentation of the results.
- C. Failure to Complete: Failure to complete requested construction progress documentation may result in the withholding of payment by Owner.

### 1.16 Closeout Procedures

- A. Notification: Contractor shall provide written notification to Owner when Contractor is satisfied that the work has reached Substantial Completion and is ready for inspection.
- B. Pre-Inspection Submittals: Contractor shall submit an electronic copy of all closeout submittals to Owner in accordance with the requirements found in these documents no less than ten (10) business days prior to the scheduled Final Inspection.
  - 1. Test Results
  - 2. As-built drawings (full-size sheets)
  - 3. Operation and Maintenance Manuals
  - 4. End User Software
- C. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in these documents, and/or unacceptable to Owner shall be documented by Owner and provided to Contractor to rectify at no additional cost. Contractor shall provide written notification to Owner when all punch list items have been completed.
- D. Final Inspection: At Owner's request, Contractor shall make Project Manager and/or Lead Technician available.

- E. Re-Inspection: If more than one (1) re-inspection is necessary, the costs of the additional travel, time, and expenses of Owner may be deducted by Owner from the contract amount due to the Contractor.
- F. Punch List Approval: Once all punch list items are complete, the Contractor shall return an initialed punch list to the Owner for verification. Punch list shall be considered complete only after having been signed by Owner.
- G. Closeout Submittals: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide three (3) electronic copies to Owner in format(s) noted below.
  - 1. Record Drawings – AutoCAD 2010 editable .dwg format AND PDF.
  - 2. Operation and Maintenance Manuals – CD OR DVD.
  - 3. End User Software – CD OR DVD.
  - 4. Documentation of testing and system certification.
- H. Closeout Submittal Format and Distribution: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide a total of three (3) bound hard copies and one (1) digital copy with labeled dividers of all record drawings (full-size sheets) and operation and maintenance manuals, three (3) copies to Owner and one (1) digital copy to Owner. Title on front and spine of binder shall be “Operation and Maintenance Manual – [Project Name]”. The following additional items shall be identified on the binder cover:
  - 1. Client Name
  - 2. Contractor Name and Contact Information
  - 3. Date
- I. All documentation prepared by the Contractor, including hard copy and electronic forms, shall become the property of the Owner.
- J. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by Owner, including punch list(s) and/or re-inspection(s) and delivery of closeout deliverables.

#### 1.17 Closeout Submittals

- A. Closeout submittals are intended to document the details of the final installation that substantially conforms to the construction documents and functions as intended to meet the Owner’s needs.
- B. Contractor shall provide to Owner the following closeout submittals for approval in addition to specific requirements identified in subsequent sections.

1. As-built drawings: As-built drawings are prepared by the Contractor. They show, in red ink, on-site changes to the Owner-approved pre-construction submittal documents. As-built drawings shall be submitted to Owner for approval prior to submitting record drawings and include:
  - a. Changes made by Addenda, Change Orders, Requests for Information (RFIs), Architect's Supplemental Instruction (ASIs), or Requests for Proposal (RFPs) in addition to any other changes to the original documents.
  - b. Actual device locations, conduit routing, wiring and relationships as they were constructed.
  - c. Nomenclature showing as-built wire designations and colors.
  - d. Room numbers coinciding with Owner space planning numbering.
2. Record drawings: Record drawings are the final drawings prepared by the Contractor and incorporate all as-built drawing changes previously approved by Owner. Record drawings should be electronically produced without any handwritten, red ink, or clouded changes.
3. Operation and Maintenance Manuals: Notwithstanding requirements specified elsewhere, submit one (1) copy of each of the following per binder:
  - a. A final Bill of Materials for each system.
  - b. A Microsoft Excel (.xlsx format) spreadsheet for each device that resides on the network provide the following:
    - i. IP Address
    - ii. MAC Address
    - iii. Serial Number
    - iv. Manufacturer
    - v. Model Number
    - vi. Device Username
    - vii. Device Password
    - viii. Telecom Closet or Rack Location
    - ix. Patch Panel Port Number
    - x. Switch Port Number
    - xi. Any other relevant information as requested by Owner
  - c. Manufacturers Instruction Manuals: Specification sheets, operation manuals and service sheets published by the manufacturers of the components, devices and equipment provided.
  - d. Information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.

- e. Replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.
  - f. Performance, Test, and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
  - g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturers' Warranty Registration papers as described herein.
  - h. Sufficient information, (detailed schematics of subsystems, assemblies, and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.
  - i. Any other items defined herein.
4. Local Reference Diagrams: Within each equipment rack, enclosure, or cabinet, the Contractor shall place a functional diagram of the system(s) in a clear plastic sleeve secured to the equipment rack, cabinet, or enclosure.
  5. Intellectual Property: Provide all required items and written release as described herein.
  6. Spare Parts and Remote Controls: Contractor shall submit record of Owner sign-off of turnover of spare parts and remote controls.

#### 1.18 Project Management

- A. Project Manager: Contractor shall appoint a Project Manager who will be the main point of contact for Owner regarding the project.
- B. Responsibility: Project Manager is responsible for the following:
  1. Successfully completing the contract in a timely manner.
  2. Overseeing work and performance of all employees and Subcontractors who have been hired by Contractor, and ensuring compliance with specification.
  3. Completing and submitting required documentation.
  4. Attending project coordination meetings as required by Owner and Contractor. Contractor is responsible for taking minutes of these meetings and distributing copies to all participants in a timely manner.
  5. Coordinating with Owner, Prime Contractor, and other Contractors involved in the project to ensure smooth flow of work and on-time project completion.
  6. Providing a written weekly progress update to the Owner in a PDF format emailed to the project team.
  7. Reporting all unexpected conditions and problems that may result in delay or expense to Owner immediately upon discovery.

- C. Change of Project Manager: If Contractor seeks to change Project Manager during the course of the Project, such change is subject to prior written approval from Owner.
- D. The Owner reserves the right to request a change of project manager at any time for any reason.

#### 1.19 Examination of Existing Conditions

- A. Examination: Contractor shall examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work. Other documents (Architectural Drawings, hardware schedules...) may be made available upon request. Failure to adequately complete the examination shall not result in change order requests.
- B. Acceptance of Conditions: Commencement of work by Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to Owner prior to commencement.
- C. Observation: If Contractor observes—during preliminary examinations or subsequent work—existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to Owner in a timely manner.
- D. Pre-Existing Damage: If Contractor observes damage to finished surfaces before they begin installation in any area, Contractor shall document by taking digital photos of the damaged area(s) and immediately notify Owner via email with attached photos.
- E. Damage during Installation: Any damage caused by, or reasonably believed by the Construction Manager to be caused by the Contractor shall result in back-charges for said damages. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

#### 1.20 Product Storage and Handling Requirements

- A. Storage: Contractor shall provide secure material storage. If Contractor chooses to store cabling or equipment at project site, that Contractor shall receive written approval from GC or Owner to identify acceptable location. All equipment provided by the Contractor remains the responsibility of that Contractor until Owner has beneficial use of the equipment.
- B. Protection: Contractor shall take all necessary precautions to protect materials from the following:
  - 1. Theft
  - 2. Vandalism/Tampering

3. Dents
  4. Scratches
  5. Dust
  6. Temperature
  7. Weather
  8. Cutting
  9. Paint
  10. Other hazardous conditions
- C. Replacement: Contractor shall replace any damaged or lost material as required by Owner.
- D. Installed Materials: Installed materials remain the responsibility of the Contractor until Acceptance. Contractor shall take necessary precautions to ensure the safety and security of installed materials.
- 1.21 Interference with the Facility
- A. Transportation and storage of materials at the facility, work involving the facility, and other matters affecting the habitual use by the Owner of the Owner's buildings, shall be conducted to minimize interference, and at times and in a manner acceptable to the Owner.
- 1.22 On-Site Conduct
- A. Conduct: Any demonstration of rudeness, use of profanity, or lack of respect by Contractor Personnel to a building tenant will be cause for immediate removal from the premises, and such Personnel will not be allowed to return. Contractor and Contractor's Personnel are to remain in project area.
- B. Vandalism: Graffiti or vandalism will not be tolerated. Any Contractor/Personnel caught in the act shall be immediately removed from the premises and will not be allowed to return.
- C. Hazardous Conditions: No one shall be allowed to endanger the building, its premises, or its occupants in any manner whatsoever. In the event that a situation occurs which threatens the building or its occupants in any manner, Contractor, Contractor Personnel, Subcontractor, etc. shall take immediate steps to correct the hazardous condition. In the event that Contractor's Personnel fail to correct hazardous condition, Owner reserves the right to immediately take steps to correct the situation at Contractor's expense.



### 1.23 Safeguards and Protection

- A. Barriers: Provide and maintain suitable barriers, guards, fences and signs where necessary to accommodate the safety of others relative to and/or for the protection of this work.
- B. Regulations: Comply with OSHA, Federal, State, Local, and Owner regulations and standards pursuant to this work.
- C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.
- D. Finishing: Check, clean and remove defects, scratches, fingerprints and smudges if necessary from all equipment and devices immediately prior to Acceptance of the Installation.
- E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.
- F. Documentation: Provide written description of accidents by workers, staff, and general public of any incident occurring on the project. Report incident in writing to Owner's representative immediately and to the Project Manager for follow up.

### 1.24 Owner-Furnished Products

- A. Delivery: Owner is responsible for delivery of Owner-furnished products to the project site, unless otherwise specified in this document.
- B. Placement: Contractor is responsible for locating, inspecting, and moving Owner-furnished products to their final installation position.
- C. Inspection: Contractor shall report any damage, discrepancies in quantity, type, or function to Owner immediately upon discovery.
- D. Warranty: Contractor assumes no responsibility for any material warranty for Owner-furnished products. Contractor shall be responsible for integrating, cabling, and installing Owner-furnished products under the same warranty conditions as other products furnished by Contractor.

### 1.25 Quality Assurance

- A. Assurance: It is the intent of these specifications to describe and provide for a complete, professional, and reliable installation.
- B. Qualifications: Contractor employees who are engaged in installation shall be properly trained in the tasks they are expected to perform.
- C. Acceptability: Owner shall determine the acceptability of work.

- D. Regulatory Requirements: Contractor shall comply with code requirements that apply to the work being performed.
- E. Certifications: Where manufacturer certifications are required for warranty or for authorized resale, installation personnel shall have received such certification prior to the start of installation of those manufacturers' materials.

#### 1.26 Quality Control

- A. Installation: During installation period, when connections are made to the Owner's existing infrastructure, Contractor shall use care to ensure that such connections will not have a negative impact which could reduce or hamper existing systems.

#### 1.27 Owner's Right to Use Equipment

- A. The Owner reserves the right to use equipment, material and services provided as part of this work prior to Acceptance of the Work, without incurring additional charges and without commencement of the Warranty period.

### **Part 2 - Products**

#### 2.01 Basic Equipment and Materials Requirements

- A. Standards: Equipment and materials used to accomplish the goals of this project shall meet standards for good engineering practice as defined within this document.
- B. Quality: Products specified in these documents are intended to establish a baseline or operational, functional, and performance-based standards that all proposed products shall meet or exceed by functionality and quality.

#### 2.02 Factory-Assembled Products

- A. Manufacturer: Reference to specific equipment manufacturers does not imply that all products produced by that manufacturer meet the specification requirements.
- B. Age of Equipment: Equipment shall be new and unused with full manufacturer's warranties. Contractor shall supplement such warranties as required by the specification. Contractor shall immediately notify Owner of any product that will be or is expected to be discontinued by the end of the project for resolution.
- C. No Modification: Where a product is available from a factory/manufacturer to meet the needs as outlined, that product shall be used without modification to ensure the full factory warranty is maintained.
- D. Like Materials: Like materials used shall be of the same manufacturer, model, and quality unless otherwise specified.
- E. Software/Firmware: No software or firmware is to be used unless specifically authorized by Owner or its appointed representative.

### 2.03 Racks, Cabinets, Hardware

- A. Equipment Racks and Cabinets: Provide racks and cabinets as specified herein and/or described in accompanying documents, appendices, or drawings. Verify that any existing racks and/or cabinets provided by others are complete, bringing any discrepancies to the attention of Owner prior to beginning the installation.
- B. Shelves and Mounts: Contractor shall supply necessary mounting hardware to install rack-mounted equipment. Mounting hardware shall be a product of the manufacturer of the equipment to be mounted, or manufacturer of the rack system, or approved by either for use with their product. Provide supporting channels, shelves, rack mounts, and/or rack ears as recommended by equipment manufacturers.
- C. Screws and Washers: Contractor shall provide screw head types appropriate to the level of security required for the equipment and racking. Screws shall include polyethylene or nylon washer.
  - 1. Public Access Areas: Star post or square post security screws shall be used for hardware and equipment mounted in equipment racks and consoles in areas that are accessible to the public.
  - 2. Restricted Access Areas: Philips head screws may be used where a secure room entrance or locked rack/console door prevents public access.

### 2.04 Power Devices

- A. Power Strips: Unless otherwise specified, power strips shall be UL listed, surface mounted, and rated for 20 amp continuous electronic loads. Outlets shall be 125 volt, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Cords shall be 12/3 SJT with molded plug.
- B. Power Distribution Panels: Unless otherwise specified, power distribution panels shall be UL listed, rack mounted, rated for 20 amp continuous electronic loads, with switch and pilot light. Up to eight outlets shall be mounted to the back, each rated 125 volt, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Switch and pilot shall be mounted to the front. Cords shall be 12/3 SJT with molded plug.
- C. Contractor shall provide acceptable power distribution units as required in order to provide sufficient outlet connectivity for Contractor-furnished and Owner-furnished equipment indicated on drawings and equipment schedules, plus up to 15% additional capacity for future growth. This may be in addition to any power distribution equipment indicated on equipment schedules.

### 2.05 Cable and Connectors

- A. Cable: Cable shall be selected and applied in a manner defined by signal type, consistent with best industry practices. Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material

characteristics. Where required by the NEC, substitutions of air handing plenum cable shall exactly match the normally applied product and shall meet the standards of UL Standard #900 and the NEC Articles 800 and 820.

- B. Connectors: Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material characteristics. Strain reliefs and cable clamps shall be sized for the connector and the cable.
- C. Color: Cable and connector color shall be coordinated with Owner to maintain consistency with cable and connector color schemes used by other trades.

#### 2.06 Cable Management

- A. Plastic Cable Ties: Single use white nylon plastic cable ties, appropriate screw fittings, or mounting clips may be used for AC power cable management within racks and enclosures. Plastic/nylon cable ties shall not be used for signal and DC cables.
- B. Velcro Cable Ties: Velcro straps shall be used for all signal and DC cables. Velcro straps shall be black, with no logo or decoration, except as authorized by Owner.

#### 2.07 Ancillary Hardware

- A. General: Contractor shall provide ancillary and required accessory items necessary to provide a complete and fully functional system to Owner.
- B. Interpretation: Exclusion of or limitation in the language used in the drawings or specifications shall not be interpreted as meaning that ancillary or accessory items of work or equipment necessary to complete or make the installed system fully functional can be omitted.

#### 2.08 Fire Stopping Materials

- A. All penetrations of walls shall be approved before any penetrations are made. Should the Contractor find it necessary to penetrate any walls extending to the slab, it will be the responsibility of that Contractor to provide satisfactory sleeving and fire caulking both inside and outside of that sleeving. If existing sleeving is to be utilized, it will be the responsibility of the Contractor to fire caulk inside the sleeving.
- B. The Contractor is responsible for adhering to the following standards:
  - 1. Conduit penetrations through fire-rated or smoke walls: Completely seal around the conduit penetration with Hilti FS 601 fire-rated sealant or equivalent by Tremco, 3M, or equal.
  - 2. Conduit sleeves through fire-rated or smoke wall: Completely seal around the conduit penetration with Hilti FS 601 fire-rated sealant or equivalent by Tremco,

3M, or equal. Completely seal inner opening of the conduit sleeve with fire wool packing and Hilti FS 611A intumescent firestop sealant.

3. Cable bundles through fire-rated or smoke walls (without sleeves): Completely seal openings with Hilti FS 611A intumescent firestop sealant or equivalent by Tremco, 3M, or equal.
  4. Cable tray penetrations through fire-rated or smoke walls: Completely seal openings with Hilti FS 635 (trowelable type), or equivalent by Tremco, 3M, or equal.
- C. A submitted response to this specification assumes that all firestopping will be provided as specified. The firestop manufacturer's specifications and instructions shall be submitted with the final documentation.

#### 2.09 Compatibility of Related Equipment

- A. Existing Equipment: Equipment and systems specified in these documents shall be assumed to be compatible with the systems already installed at Owner site(s) and as identified in this document as related to this project.
- B. Installed Equipment: Specified equipment and systems shall be compatible with all other equipment and systems as offered by Contractor, thus placing the responsibility on Contractor to ensure proper interaction.

#### 2.10 Licenses

- A. Any and all licenses required for system functionality shall be provided.

#### 2.11 Spare Parts

- A. Suggested List: Contractor is requested to submit a list of suggested spare parts with an offered price, allowing Owner to select appropriate parts.
- B. Means of Obtainment: Contractor shall state where spare parts can be obtained after the installation.

#### 2.12 Maintenance Manuals

- A. Contractor shall produce a maintenance manual showing interconnection of equipment and any special procedures necessary for proper operation and maintenance of the systems.

### Part 3 - Execution

#### 3.01 General

- A. Contractor shall provide, furnish, deliver, transport, erect, install, connect and configure all of the material and equipment described herein or depicted on any bid package document or drawing, as required for a turnkey solution.

### 3.02 Coordination

- A. General: Contractor shall cooperate with other Contractors for proper provisioning, anchorage, placement, and execution of all work. Interference between the work of various Contractors shall be resolved before installation. In the event of conflict on space requirements or location of devices, refer the matter to Owner for decision.
- B. Related Work: References to the following related work do not limit or release Contractor from the responsibility of coordination with other trades or from having the necessary knowledge of other non-referenced work.
  - 1. Work by Prime Contractor.
  - 2. Work by other Technology Contractors.
  - 3. Work by Electrical Contractor, including electrical rough-ins and surface-mounted raceway.
- C. Delays: Contractor shall coordinate with all other trades to avoid causing delays in the installation schedule.
- D. AC Power: Contractor shall provide an electrician as required to perform all 120VAC work necessary for the project.

### 3.03 Basic Execution Requirements

- A. General: Contractor is responsible for following industry standards of good practice for telecommunications and networking equipment.
- B. Aesthetic Factors: With the installation of equipment and cables, consideration shall be given not only to operational efficiency but also to overall aesthetic factors. Contractor shall redo, at no cost to Owner, any work deemed by Owner to appear sloppy, hastily done, or unprofessional. Owner shall make final decision over whether work shall be redone.
- C. Manufacturers' Recommendations: Manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless otherwise noted herein.
- D. Protection of Work Area: Work shall be properly protected during construction; including shielding soft or fragile materials, protecting against dust and dirt, protecting and supporting cable ends off of the floor and from other traffic, protecting floor box lids, and temporarily plugging open conduits during construction. Upon completion, installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of work shall be removed from the premises.
- E. Protection of Cable and Equipment: Contractor shall make appropriate preparations to protect all cabling and equipment from foreign material. Foreign material is

defined as any substance or material that would void the manufacturer's performance warranty, impact ratings (UL, Plenum, etc.), or cover up markings needed for inspection. Foreign material includes, but is not limited to, paint overspray (intentional or not), fire-stopping material, drywall compound, or any other chemical, liquid, or compound that could come in contact with cables, cable jackets, cable termination points, or other equipment.

1. Cleaning of cables or equipment with harsh chemicals from a failure to comply with Protection of Cable and Equipment clause is unacceptable. Contractor shall replace any affected cable, cable components, or equipment in their entirety at Contractor's sole cost.
- F. Waste Materials: Contractor shall keep work area neat, orderly, and free from accumulation of waste materials. Remove trash and debris from the building and job site as required to maintain a clean work environment at all times. Rubbish shall be moved to a common trash point or receptacle on the job site as determined and directed by Prime Contractor or Owner.
- G. Dumpsters: No construction debris shall be placed in building's dumpsters. Contractor shall provide a dumpster for construction waste and debris at own expense. Said dumpster shall be emptied on a regular schedule. Location of dumpster shall be arranged through Building Management. Appropriate measures shall be taken to protect asphalt or other ground surfaces.
- H. Ceiling Grid: Contractor shall not hang cable supports from ceiling grid wire.
- I. Roof Deck: Contractor shall not shoot into the roof deck for mounting cable hangers.
- J. Mounting: Equipment and enclosures shall be mounted plumb and square in relation to the structure.
- K. Raised Floor: All cabling installed below the raised floor shall be placed in the provided cable trays with appropriate means to hold cable in place. If no cable tray exists, Contractor shall provide J-hooks to hold cables in place. Sleeves shall be utilized for cable egress.
- L. Motorized Furniture: Care shall be taken to properly dress all cables placed within motorized furniture and provide sufficient cable length and strain relief to allow motorized elements to operate within their full range of travel.
- M. Flexible Furniture: Care shall be taken to properly dress all cables placed within flexible or re-configurable furniture to provide sufficient cable length and strain relief to allow full range of travel for flexible furniture configurations.

### 3.04 Preparation

- A. Existing Equipment: Prior to any installation, the Contractor shall prepare the site by removing any remaining debris, leveling equipment racks (where appropriate), and verifying information and systems stated to be in-place are ready for use.
- B. Equipment for Installation: Prior to installation, Contractor shall ensure that required major equipment has been secured and is ready for installation.

### 3.05 Cleaning

- A. Tool Clean-up: Contractor is not permitted to use restrooms for tool clean-up. A slop-sink may be provided in janitorial closet on each floor for cleaning of tools and equipment and as a source of water. Janitorial closet or maintenance area or shop shall be kept clean at all times. Contractor or Contractor's Personnel found using restrooms for clean-up or other similar purposes shall be subject to removal from building.
- B. Daily: At the end of each work period or day, Contractor shall remove excess packing, drilling remnants, and other non-equipment related parts, materials, or debris to ensure a clean, safe, and professional working environment.
- C. Carpet: Contractor shall ensure that no damage to carpeting occurs as a result of their work. Contractor shall cover carpets in areas of work to prevent wire and other debris from entering the carpet.

### 3.06 Demolition

- A. General: The Contractor shall be responsible for removal, collection, transportation, and recycling of all cabling and components that become abandoned as a result of this project. This shall include the delivery of cable and components to the proper recycling centers. If material is to remain on site for more than seven days after removal, Contractor shall coordinate with Owner for an acceptable storage location.
- B. Verification: Contractor shall field-verify existing conditions prior to beginning demolition work. Any discrepancies shall be reported to the Owner prior to the start of work in order to prevent disturbance of existing installation(s). Beginning work shall indicate acceptance of existing conditions. Contractor is responsible for immediately restoring any outages caused as a result of removing or damaging adjacent cabling, systems, or services.
- C. Abandoned Cable: The Contractor shall remove all abandoned cable back to the headend. Where it is not possible to remove cables without damaging other cables that are to remain, such as in a shared conduit, the Contractor shall report these conditions to the Owner for approval. These cables shall be cut at entry and exit points, leaving a minimum of 24" of cable at each end.



- D. Cover Plates: The Contractor shall provide and install blank cover plates for any outlets or junction boxes that are to be left in place and from which all cables have been removed. Cover plates shall match the Project standard color and finish.
- E. Equipment: The Contractor shall remove all equipment abandoned as part of this project. The Contractor shall be responsible for the delivery of this equipment to a proper recycling facility. Any electrical service connected to the equipment shall be properly decommissioned and labeled to prevent any safety issues.
- F. Right of Refusal: The Owner shall have first right of refusal to any abandoned cable or equipment. The Owner has the right to remove any components from the equipment before it is recycled.

### 3.07 Fire Stopping

- A. Contractor is responsible for applying fire-stopping material in and around all openings that it creates or are created for it, whether or not specifically indicated in specifications or project drawings, where code requires the use of fire stopping material.
- B. Contractor shall ensure that all fire-stopping materials meet appropriate codes and are installed in a neat and workman like manner.

### 3.08 Waterproofing

- A. Contractor is responsible for creating a waterproof seal in and around any openings to the outside environment that are created by Contractor or for systems being installed.
- B. Contractor shall ensure that all waterproof materials meet appropriate codes and are applied according to good engineering practice.

### 3.09 Racks, Cabinets, and Hardware

- A. Racks and Cabinets: Contractor shall assemble and install racks and cabinets.
- B. Installation Hardware: Install hardware in a secure manner. Screws shall be tightened to a torque just sufficient to secure equipment without deforming washers beyond their original diameter.
- C. Considerations: Rack mount equipment shall be secured as recommended by the manufacturer with consideration to airflow, power, and in/out connections.
- D. Cross Connections: Where cross connections are required between equipment, interconnections shall be installed using cable management devices to secure cables in a neat and workmanlike manner, applying best industry practices.

### 3.10 Installation Requirements

- A. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.
- B. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of pathway entry and exit.
- C. All cable shall be free of tension at both ends.
- D. PLENUM rated cable shall be used in areas used for air handling or where required by code.
- E. Contractor shall replace any cables that have been damaged or abraded during installation.
- F. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway.

### 3.11 Cable

- A. Cable treatment: Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the rating of the manufacturer.
- B. Splicing
  - 1. Voice, data, and other twisted pair cables: No splices shall be installed in any voice, data or twisted pair cables.
  - 2. Technology systems: No splices shall be installed in any cable less than five hundred (500) feet in length.
- C. Lengths
  - 1. Variations: Where cables are to be of the same length, variations in the length shall be less than plus or minus ½ inch. Lengths of cables are based on the length of the unterminated signal conductors.
  - 2. Labeling: Cables, regardless of length, shall be marked with a labeling scheme approved by Owner.
  - 3. Service Loops: A surplus of cable, located at or near the point of termination to facilitate potential future changes, shall be provided where appropriate. Cables shall have a minimum cable slack of 10ft (3m) at the telecommunication room(s)

and 3.28ft (1m) at each telecommunications outlet in the suspended ceiling unless noted otherwise. Service loops shall be stored in an extended loop or in a figure-eight configuration, not in bundled loops.

D. Grouping

1. Cables shall be separated into like groups according to signal or power levels.
2. Power Cable Group: Power cables shall be secured to one side of the rack separate from any low-energy signal cable groups. Separation shall be a minimum of 4" in all directions.
3. Signal Cable Group: Signal cables shall be grouped according to signal type and secured to one side of the rack separate from any power cable groups. Separation shall be a minimum of 4" in all directions.

E. In Equipment Racks

1. Equipment rack wiring and cabling shall be neatly dressed.
2. Fastening: Rack cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame.

F. Support for Cables Outside of Equipment Racks

1. External wire and cables shall be supported at least every 5 feet (1.5m) from the structure and as required to maintain less than 12 inches of cable sag between supports without over-tensioning the cables. Contractor shall vary the precise distance between cable supports on long runs to avoid harmonics issues.
2. Hardware: Cables shall be supported by J-hooks, cable tray, or ladder rack. Hardware shall be secured to building structure using 3/8" threaded rod supports.
  - a. Right Angles: Cables are to run at right angles to the structure, placed above ceiling in halls or corridors.
  - b. Height: Cables shall not run above red iron joist.

G. Concealment: Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests. Cabling systems installed in public areas shall be installed within walls, ceiling, or floors or within surface wiring pathways, as dictated by codes and good engineering practice.

H. Velcro Straps for Horizontal Cabling: Straps shall be installed snugly without deforming cable insulation. Straps shall be spaced at uneven intervals not to exceed 4 feet.

I. Cable Ties and Velcro Straps within Equipment Racks and Cabinets: Ties and straps shall be installed snugly, without deforming cable insulation, at uneven intervals not

to exceed 8 inches. Cable ties shall only be used for non-signal carrying cables. No sharp burrs shall remain where excess length of the cable tie has been cut.

- J. Obstruction: Contractor shall notify Owner immediately if any obstruction or hazard is discovered in a pathway provided by others.

### 3.12 Connectors

- A. Preparation: Cables shall be carefully prepared and connectors installed as directed by the manufacturer. Proper stripping devices and crimping tools shall be used.
- B. Terminations: Connectors shall be carefully fitted to mating devices on equipment to avoid damage to mating contacts, inserts, or bodies. Specialized terminations shall be made in a neat and secure manner suited to the service of the wire and as directed by the manufacturer. Contractor shall use manufacturer specified terminations when those specifications exist.
- C. Soldering: A person skilled in that practice shall execute soldered terminations. Any excessive insulation displacement resulting from soldering shall be grounds to require the Contractor to re-terminate the connector.
- D. Adapters: Adapters shall be used only where the identity of the necessary type of connector is unknown at the time of installation, such as for Owner-provided equipment or in anticipation of future equipment upgrades, with Owner's approval.

### 3.13 Spare Parts and Keys

- A. Keys: Contractor shall turnover all keys, tagged and organized by type on individual key rings, to Owner upon project completion.
- B. Refer to individual sections for spare parts requirements.

### 3.14 Equipment Installation

- A. General: Contractor shall make system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed. Discrepancies in installation procedure or inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to Owner immediately upon discovery.
- B. Equipment Placement: Contractor shall locate equipment as indicated on drawings and as specified herein. Where such information is not provided, Contractor shall follow industry best practices and locate operable devices at convenient positions; heat generating devices at the top and seldom-accessed equipment below.
  - 1. Unless otherwise specified, end user-operable devices shall be positioned within the range of front wheelchair access per ADA standards.

- C. Equipment Installation: Equipment shall be installed as directed by the manufacturer using equipment manufacturer's desktop mounting frames, equipment tubs, installation hardware, and techniques. Contractor shall be responsible for moving equipment from storage and for providing necessary personnel or devices to carry and lift equipment around obstacles and into operating position.
- 3.15 Firmware
- A. Firmware shall be latest version supported by software and/or equipment as of Date of Acceptance.
- 3.16 Rough-In
- A. Scheduling: Contractor shall make every effort to install systems per this specification in a timely manner including rough-in of cabling and other apparatus where appropriate to stay on schedule.
  - B. Protection of Environment: Where cabling and/or equipment is installed prior to other trades completing their work in an area, Contractor shall take necessary precautions to cover, wrap, or otherwise protect to reduce possible damage which may result from plastering, painting, cleaning, or other such work completed after installation and before substantial completion of the project.
- 3.17 Cutting, Drilling, Patching, and Painting
- A. Coordination: Contractor is responsible for coordinating when any cutting or drilling is required for the installation or proper performance of the specified systems.
  - B. Restoration: Contractor is responsible for returning all surfaces (including walls, floors, and ceilings) to their previous condition after any cutting.
- 3.18 Labeling
- A. General: Rack-mounted equipment and hardware shall be labeled as required herein. Connectors, jacks, receptacles, outlets, cables, cable terminations, terminal blocks, rack mounted equipment, active slots of card frame systems, etc. shall be clearly, logically, and permanently labeled in a manner acceptable to Owner.
  - B. Approval: Proposed wording and/or numbering schemes for labeling shall be provided to Owner for review and written approval prior to procurement or installation.
  - C. Labels used shall be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:
    - 1. Like Size: All labels, including engraved labels, shall be sized to match other labels used for same purpose.

2. Equipment Racks: For enclosed racks containing equipment, provide labels on each equipment rack rear door or console rear panel reading "No user serviceable parts. Refer service to qualified technician."
3. Installer and Owner Identification: Position at the front top center section of each equipment rack a label that states the names of system Installer and Owner.
4. Custom Panels: Custom panel nomenclature shall be engraved, etched, or screened. Markings are to be designed to ensure consistency and clarity within and without of system. Verify markings and placements by submitting label sample layouts to Owner for approval prior to procurement.
5. Documentation: Labeling information shall appear on the as-built drawings.

### 3.19 Fire-Stopping

- A. If Contractor removes anything from an opening in a fire-rated wall, Contractor shall restore the fire-rating condition of the wall to the same condition as before Contractor started its work. Depending on the size of the opening, this may involve sheetrock patching, in addition to use of other appropriate fire-stopping materials

### 3.20 Additional Engineering Services

- A. General: Contractor is responsible for securing necessary engineering services where needed to meet the needs of the installation.
- B. Change Orders: Only when Contractor can show that additional engineering services are needed as a result of changes to the scope of the services being requested in the contract documents will Owner entertain a Change Order Request for these services.

### 3.21 Testing

- A. Procedure: Contractor shall develop a rigorous testing procedure to ensure full functionality and durability of installed systems under heavy-use conditions.
- B. Supplies: Contractor shall supply testing equipment needed to verify compliance with specifications found in these documents.
- C. Schedule: Contractor shall complete required testing prior to the substantial completion inspection by Owner.
- D. Data: Test data shall be properly documented and recorded so that it is available for final inspection.
- E. Quality Control: Testing may be repeated during the inspection process at the request of Owner.
- F. Prior to energizing or testing the system, Contractor shall ensure the following:

1. Installation: Products are installed in a proper and safe manner per the manufacturer's instructions.
2. Cleanliness: Products are neat, clean, and unmarred and parts securely attached. Dust, debris, solder, splatter, etc. is removed.
3. Cables and Connections: Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
4. Grounding: Electronic devices are properly grounded.
5. AC Power: Each AC power receptacle is tested with a circuit checker for proper hot, neutral, and ground connections prior to connecting equipment.

### 3.22 Warranty and Maintenance Program

- A. Contractor shall provide a warranty conforming to the stipulations below in addition to specific requirements identified in subsequent sections.
- B. As part of the base proposal cost, the Contractor shall include a 1-year turnkey warranty period with full support costs. Software maintenance programs may be required but may not include Contractor support.
- C. The Warranty period shall begin after all punch list items have been rectified. The Contractor shall receive a letter of completion from the Owner indicating project completion and starting the warranty period.
- D. The warranty and support work included in this contract shall cover the following materials, software, and services, without additional cost to the Owner:
  1. Inspections, preventative maintenance, and testing of equipment and components. The Contractor shall schedule a 10-month on-site preventative system review 10-months into each year of warranty and support including system inspections, preventive maintenance, software upgrades/patches, and testing of equipment and components.
  2. Regular Service, Emergency Service, and Normal Service.
  3. Labor, travel, equipment, materials, and transportation cost for all services covered by this warranty.
- E. Response Time: Contractor shall respond to calls for warranty services in a timely manner as delineated below.
  1. The Owner reserves the right to make the final determination of emergency or normal service calls and the right to coordinate the best times for service of any system failure.
  2. Emergency service calls are defined as failures which prohibit the use of a typical system function(s) and pose a life safety concern, or such failures which cause a major impact to the Owner's daily operations.

- a. The Contractor shall provide remote service diagnosing the impact within two (2) hours after notification by the Owner.
  - b. If remote service does not correct the reported issue, the Contractor shall provide on-site service correcting the impact within four (4) hours after notification by the Owner.
3. Normal service calls are defined as failures which prohibit the use of typical system function(s) but which do not inhibit critical system usage, do not pose life safety concerns, and do not create a major impact to Owner's daily operations.
    - a. The Contractor shall provide remote service correcting the impact within twenty-four (24) hours after notification by the Owner.
    - b. If remote service does not correct the reported issue, the Contractor shall provide on-site service correcting the impact within forty-eight (48) hours after notification by the Owner.
  4. The Contractor shall supply Service Request forms and or proper contact procedure to the Owner with instructions for proper notification of the Contractor for warranty service. By following said instructions, the Owner shall constitute proper notification for any needed warranty service
- F. Repair Time: Contractor shall locally stock critical parts in sufficient quantities such that emergency repair or replacement shall be guaranteed within twelve (12) hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality and provided permanent replacement is achieved within ninety-six (96) hours. Contractor may contact the Owner for use of Owner supplied spare parts where delay of system repair will have negative impact on system performance.
- G. Transmittal: A copy of this Warranty shall be delivered to and signed for by the Owner's representative whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.
- H. Registration: Contractor shall register Warranty papers for all equipment and software in the name of the Owner and furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.
- I. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.
1. Service/Warranty Procedures: Contractor shall submit a warranty service plan containing all contact information and Owner service call directions for Owner review with project close-out submittals.
- J. Resolution of Conflicts:



1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory and stating specific areas of dissatisfaction in writing.
2. If the Contractor or his approved Subcontractor does not resolve such stated areas of dissatisfaction within ninety-six (96) hours, the Owner may appoint an alternative service agency or person to fulfill the terms of the Warranty at the expense of the Contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

### **End of Section**

## Section 28 05 00 – Physical Security General Requirements

### Part 1 - General

#### 1.01 Scope

- A. Refer to Section 28 00 00 for additional project scope information.
- B. This section describes the general product and execution requirements related to furnishing and installing Physical Security Systems.
- C. Contractor shall be responsible for providing complete and functional systems as described in this specification and project drawings.
- D. Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.
- E. Contractor shall be, or Contractor shall provide, an Electrical Contractor for provision of high voltage power and conduits/raceway, where necessary.
- F. Contractor shall be responsible for any and all related programming and end-user training unless noted otherwise.

#### 1.02 Related Work

- A. Section 28 00 00 – General Technology Requirements
- B. Section 28 10 00 – Electronic Access Control System
- C. Section 28 20 00 – Video Surveillance System

#### 1.03 Definitions

- A. Refer to Section 28 00 00 for additional definitions.

#### 1.04 Reference Standards and Codes

- A. Refer to Section 28 00 00 for additional requirements.

#### 1.05 Qualifications

- A. Refer to Section 28 00 00 for additional requirements.
- B. Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.
- C. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).

- D. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

#### 1.06 Pre-Construction Submittals

- A. Refer to Section 28 00 00 for additional requirements.
- B. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the Physical Security Systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:
  1. Server(s) processor(s), disk space and memory size
  2. Workstation(s) processor(s), disk space and memory size
  3. Description of site (field) control equipment (Controllers/Field Panels) and their configuration
  4. Operating System(s) Software, where software is provided or upgraded
  5. Application Software, with Optional and Custom Software Modules supplied in this project
  6. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information, for inter-system communication.
  7. Network reliability requirements
  8. Number and location of LAN ports required
  9. Number of IP addresses required.
  10. Other specific network requirements, preferences, and constraints
  11. Backup/archive system size and configuration
  12. Start-up operations
  13. Battery backup requirements

#### 1.07 Construction Progress Submittals

- A. Refer to Section 28 00 00 for additional requirements.

#### 1.08 Closeout Submittals

- A. Refer to Section 28 00 00 for additional requirements.
- B. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.

- C. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components with serial numbers and with a unit price greater than \$99. Organize list by room/system type.

## **Part 2 - Products**

- 2.01 Refer to individual sections for additional product information.
- 2.02 Fire Stopping Materials
  - A. Refer to Section 28 00 00 for additional requirements.

## **Part 3 - Execution**

- 3.01 Network Time Protocol (NTP) Synchronization
  - A. All security systems as well as additional integrated systems such as intercom/PA, SQL/database servers and data logging servers shall synchronize to a common NTP server.
  - B. All systems including servers and workstations shall be within 50ms of each other or less depending on specific system requirements such as failover. The synchronization frequency shall be no less than every 3 hours.
  - C. The Contractor shall coordinate with the Owner for a NTP server connection. The Contractor shall verify the accuracy of the Owners NTP server before utilizing it.
  - D. Workstations on the private security network shall have an NTP client such as NetTime operating as a Windows service to sync the workstations clock to the same NTP server as the rest of the security systems.
- 3.02 Testing
  - A. Refer to Section 28 00 00 for additional requirements.
- 3.03 Warranty
  - A. Refer to Section 28 00 00 for additional requirements.
  - B. Furnish and guarantee maintenance, repair and inspection service for the system using factory trained authorized representatives of the manufacturer of the equipment for a period of one year after final acceptance of the installation.
  - C. Third Party Device warranties are transferred from the manufacturer to the Contractor, which may then transfer third party warranties to the Owner. Specific third party warranty details, terms and conditions, remedies and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product. These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer.

D. Purpose

1. The Contractor shall repair any system malfunction or installation deficiency discovered by the Owner or their representatives during the burn in and warranty period.
2. The Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner or their representatives during the warranty period.

3.04 Examination of Site and Documents

- A. Bidder shall examine all documents, shall visit the site(s) prior to submitting proposal, record their own investigations, and shall inform themselves of all conditions under which the Work is to be performed at the site(s) of the Work, including the structure of the ground, the obstacles that may be encountered, and all of the conditions of the documents, including superintendence of the Work, requirements of temporary environmental controls, the time of completion, list of Subcontractors, and all other relevant matters that may affect the Work or the proposal process.
- B. Verify cable lengths comply with published standards.
- C. Notify Owner of installation that would exceed maximum lengths prior to installation of cable.
- D. Contactor shall consult with Owner regarding alternative routing or location of cable.
- E. Do not proceed until unsatisfactory conditions have been corrected.
- F. Failure to make the examination shall not result in any Change Order requests.
- G. The Bidder shall base the proposal on the site(s) examination, materials complying with the plans and specifications and shall list all materials where the proposal form requires.
- H. The commencement of work by the Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to the Owner prior to commencement.
- I. If the Contractor observes, during preliminary examinations or subsequent work, existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, the Contractor shall report these to the Owner in a timely manner.

3.05 Installation Requirements

- A. Refer to Section 28 00 00 for additional requirements.

- B. Contractor shall furnish and install all cables, connectors, and equipment as shown on Drawings and as specified herein.
- C. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.
- D. Beginning installation means Contractor accepts existing conditions.
- E. The Contractor shall be responsible for identifying and reporting to the Prime Contractor any existing damage to walls, flooring, tiles, and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway, or other hardware shall be repaired by the Contractor.
- F. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor-damaged ceiling tiles, floor, and carpet shall to be replaced to match color, size, style, and texture.
- G. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.
- H. All wiring shall be run "free-air," in conduit, in a secured plastic raceway or in modular furniture as designated on the Drawings. All cable shall be free of tension at both ends. PLENUM rated cable shall be used in areas used for air handling.
- I. Avoid abrasion and other damage to cables during installation.
- J. The cable system will be tested and documented upon completion of the installation as defined in the section below.
- K. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by manufacturers or as indicated in their published literature, unless specifically noted herein to the contrary.

### 3.06 Cooperation

- A. The Contractor shall cooperate with Owner's personnel in locating work in a proper manner.
- B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

### 3.07 Commissioning Submittals

- A. Provide the following to the Owner no later than 30 days prior to system commissioning/programming.
  - 1. Commissioning Test Plan and Check-Off List: Specified elsewhere in this document.
  - 2. Software: One set of fully functional software in manufacturer's original media packaging, temporarily licensed for a 30-day evaluation period.

### 3.08 Commissioning

- A. Provide programming and commissioning for each system as described in individual sections below.
- B. This Contractor shall develop and submit a plan for coordination of settings and programming issues with the Owner no later than 30 days prior to performing programming and commissioning.
- C. The security Contractor is required to place entire system into full and proper operation as designed and specified.
- D. Verify that all hardware components are properly installed, connected, communicating, and operating correctly.
- E. Verify that all system software is installed, configured, and complies with specified functional requirements.
- F. Perform final acceptance testing in the presence of Owner's representative, executing a point-by-point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.
  - 1. Submit documented test plan to Owner at least 14 days in advance of acceptance test, inspection, and check-off.
  - 2. Conduct final acceptance tests in presence of Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.
  - 3. Acceptance by Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.
  - 4. The system shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

### 3.09 Operation and Maintenance Manuals

- A. Part One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after Final Acceptance of the Installation:
1. Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring and relationships as they were constructed. Include nomenclature showing as-built wire designations and colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD 2010 files, in ".dwg" format, on CD or DVD disks.
  2. Manuals: Submit two (2) copies of each of the following materials in bound manuals, or electronic PDF copies, with labeled dividers:
    - a. A final Bill of Material for each system
    - b. Equipment Instruction Manuals: Complete, project specific comprehensive instructions for the operation of devices and equipment provided as part of this work.
    - c. Manufacturers Instruction Manuals: Specification sheets, brochures, Operation Manuals and service sheets published by the manufacturers of the components, devices and equipment provided.
    - d. Include information for testing, repair, troubleshooting, assembly, disassembly and recommended maintenance intervals.
    - e. Provide a replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.
    - f. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
    - g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturer's Warranty Registration papers as described herein.
- B. Part Two: Within fourteen (14) days of receipt of Owner reviewed Operating and Maintenance Manual (Phase One), submit three (3) electronic copies in AutoCAD 2010 editable .dwg format of the reviewed Record Drawings and three (3) copies of the reviewed Operating and Maintenance Manuals to the Owner, on CD or DVD disks.
1. Within each equipment enclosure and/or terminal cabinet, the Contractor shall place a Single Line drawing of the system(s) and the respective Terminal Cabinet Wiring Diagram in a clear plastic sleeve permanently attached to the inside cover of the terminal cabinet.



2. In each equipment enclosure the Contractor shall place a drawing providing device locations served by the equipment within the enclosure with identification that is identical to the wiring tags and with the software description of each point.
  3. The Contractor shall provide to the Owner one (1) copy of new administration and user software, including required graphical maps, on CD or DVD disks.
- C. Sufficient information, (detailed schematics of subsystems, assemblies and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.

### 3.10 Closeout Procedures

- A. Notification: Contractor shall provide written notification to Owner when Contractor is satisfied that the work has been completed and is ready for inspection.
- B. Closeout Submittals: Contractor shall provide closeout documentation to the Owner. The Owner shall receive the closeout submittals no less than 72 hours prior to the scheduled inspection time.
- C. Inspection: Contractor shall be present for the inspection by the Owner. Contractor shall supply all testing equipment needed to verify compliance with the specifications found in Bid package.
- D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in the Bid package, and/or unacceptable to the Owner shall be documented by the Owner and provided to Contractor to rectify.
- E. Re-Inspection: If a re-inspection is necessary, the costs of the Owner's representative additional travel, hours, and expenses may be deducted by the Owner from the contract amount due Contractor.
- F. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner.
- G. The system has successfully completed a 30-day performance period.
- H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by the Owner, including punch list(s) and/or re-inspection(s).

## End of Section

## Section 28 10 00 – Electronic Access Control System

### Part 1 - General

#### 1.01 Scope

- A. This specification section covers the furnishing and installation of a new and complete expansion to the existing enterprise-wide, low-voltage, Electronic Access Control System (EACS).
- B. Contractor shall furnish and install access control hardware devices, mounting brackets, power supplies, switches, controls, consoles and other components of the system as shown, specified and required.
- C. Contractor shall furnish and install access control related software to allow this system expansion. Software includes required license addition for access control readers and electrified portals, workstations and required physical security system Integration.
- D. Furnish and install outlets, power connections, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. The Contractor shall sub-contract an electrician as necessary.
- E. Refer to Section 28 00 00 for additional project scope information.

#### 1.02 Precedence

- A. Obtain, read and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

#### 1.03 Related Work

- A. Section 28 00 00 – General Technology Requirements
- B. Section 28 05 00 – Physical Security General Requirements
- C. Section 28 20 00 – Video Surveillance System

#### 1.04 Definitions

- A. Refer to Section 28 00 00 for additional definitions.

#### 1.05 Reference Standards and Codes

- A. Refer to Section 28 00 00 for additional requirements.

#### 1.06 Qualifications

- A. The Access Control contractor shall be a current certified dealer for Software House in good standing.

- B. Refer to Section 28 00 00 for additional requirements.
- 1.07 Pre-Construction Submittals
  - A. Refer to Section 28 00 00 for additional requirements.
- 1.08 Pre-installation Procedures
  - A. For existing facilities or retrofit projects the Contractor shall assign all applicable electronics IP addresses and pre-build out all the enclosures including the interconnects within the enclosure prior to being delivered to the project or installed to ensure a quick and smooth cutover.
  - B. Refer to section 28 00 00 for additional requirements.
- 1.09 Construction Progress Submittals
  - A. Refer to Section 28 00 00 for additional requirements.
- 1.10 Closeout Submittals
  - A. Refer to Section 28 00 00 for additional requirements.

## **Part 2 - Products**

- 2.01 Electronic Access Control Software
  - A. The College is currently on a Software House CCure 9000 system, version 2.6 SR1. The system serial number is 9-10295.
- 2.02 Electronic Access Control Hardware
  - A. The Contractor shall furnish and install new Software House iStar Ultra 8 or 16 door panels (or equivalent manufacturer) including all necessary expansion modules for a complete turn-key system.
- 2.03 Contactless Smart Card/Legacy Card Readers
  - A. 125Khz and 13.56Mhz MultiClass readers
    - 1. Credentials:
      - a. Operating Frequency: 125Khz and 13.56 MHz (ISO 15693, 14443A & 14443B).
      - b. Contactless reader shall be able to read HID Prox.
      - c. Contactless smart card reader shall implement the following high security 13.56 MHz applications out-of-box.
        - i. Secure Identity Object on HID iCLASS SE
        - ii. Secure Identity Object on HID iCLASS Seos

- d. Able to read 37-bit card format.
2. Operating voltage range: 5-16 VDC
3. Current draw: 65mA average and 200mA peak @ 12VDC.
4. Color: Black
5. IP 55 exterior rated.
6. With attached pigtail
7. Typical read range for model R15 of 3.6" with card and 1.6" with fob
8. Typical read range for model R40 of 5.2" with card and 2.8" with fob
9. Provide adapter plate to mount on a single-gang mud ring as required.
10. Firmware upgradable via pre-programmed cards.
11. Provide the ability to transmit an alarm signal via an integrated optical tamper switch if an attempt is made to remove the reader.
12. An audio beeper and RGB light bar shall provide various tone and light sequences to signify: access granted, access denied, power up, and diagnostics.
13. Card readers shall be HID MultiClass SE RP40 (920PTNNEK00000) for standard applications and HID MultiClass SE RP15 (910PTNNEK00000) for mullion applications.
14. Or equivalent

#### 2.04 Power Supplies and Access Control Enclosures

- A. Provide a power supply/chargers and sub-assemblies to power various access controller boards, locking hardware and other access control or security system components. The Contractor shall select the appropriate enclosure, power supply and sub-assemblies for each application.
- B. Enclosures
  1. Shall be capable of accommodating power supplies, sub-assemblies and other manufactures access control controller boards when required.
  2. Wall mountable.
  3. Include a cam-lock and tamper switch.
- C. Power Supplies
  1. 115 VAC input
  2. 12VDC or 24VDC selectable outputs at:
    - a. 6 amp continuous power @ 12VDC or 24VDC.

3. High capacity battery charging circuit.
    - a. Provide adequate battery backup as required by Authority Having Jurisdiction (AHJ) or a minimum of 4-hours.
  4. Form "C" supervision contacts for AC Low, AC Fail, and battery presence.
  5. Supervised Fire Disconnect.
  6. Low power Disconnect.
  7. Class 2 aux. output.
  8. UL 294 listed sub-assembly for access control.
- D. Sub-Assemblies
1. The Contractor shall provide all sub-assemblies to meet the project requirements
  2. Access Control Module
    - a. Independently controlled fused protected outputs:
      - i. Fail-Safe and/or Fail-Secure power outputs.
      - ii. Dry form "C" 5 amp rated relay outputs (fused).
      - iii. Any combination of the above
  3. Access Control System trigger inputs:
    - a. Normally open (NO) inputs.
    - b. Open collector sink inputs.
    - c. Any combination of the above.
  4. Fire Alarm Disconnect:
    - a. Individually selectable for any or all outputs.
    - b. Latching or non-latch input FACP disconnect.
    - c. Normally open (NO), normally closed (NC) dry contact or polarity reversal from FACP signaling circuit trigger input.
    - d. LED indicates that the Fire Alarm Disconnect has been activated.
    - e. Form "C" relay output for auxiliary reporting.
  5. Multi-Output Power Distribution Module with Dual Inputs
    - a. Two (2) inputs distributed over eight (8) outputs.
    - b. Outputs shall be configurable by input.
    - c. Fused protected outputs.

d. Output terminals shall accommodate up to 12AWG wires.

6. Voltage Regulator

a. The Contractor shall provide a voltage regulator to provide constant 5VDC or 12VDC outputs for access control boards, modules or other applicable components as well as a voltage regulator for door hardwiring requiring 12VDC.

b. 24vdc Input.

c. 5 or 12VDC output.

d. Output rating of 6amp max.

e. Stackable with both Networkable and dual input power distribution modules for space savings.

7. Power supplies and sub-assemblies shall be manufactured by Altronix or approved equal:

a. eFlow6NB - 6amp 12vdc/24vdc power supply (UL listed Sub-assembly).

i. Or equivalent

2.05 Door Contacts/Door Position Switches (DC)

A. The Security Contractor shall be responsible for the connection of all door position devices to the access control system. Door position devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements.

B. Sealed and potted magnetic reed switch in contact housing.

C. Provide color that matches door as close as possible.

D. Provide recessed switch whenever possible.

E. Armored whip for surface mount contacts.

F. Provide UTC Interlogix 1078 Series for recessed applications.

1. Or approved equal.

G. Provide UTC Interlogix 2500 Series for surface mount applications.

1. Or approved equal.

H. Provide UTC Interlogix 2200 Series for overhead door applications.

1. Or approved equal.

## 2.06 Request to Exit (REX) Devices

- A. The Security Contractor shall be responsible for the connection of all request to exit devices integral to the door, motion based or other to the access control system. Request to Exit devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements. Motion based Request to Exit devices shall only be used when not available in the door hardware.
- B. The motion based REX shall be a dual technology device with Passive Infrared (PIR) and Range-Controlled Radar (RCR) motion detector.
- C. Reduces false alarms by sensing both heat and physical motion.
- D. Independent adjustable beam pattern and radar depth.
- E. Provide with mounting plate or wall mounting plate to mount over a single-gang backbox when required.
- F. Provide color that matches door as close as possible.
- G. DPDT output.
- H. DC Power draw: 28mA max @ 12 VDC, 17mA max @ 24 VDC.
- I. AC Power draw: 38mA max @ 12 VAC, 29mA max @ 24 VAC.
- J. Dimensions: 1.76”H x 7.395”W x 1.85”D.
- K. Utilize contact closure REX hardware built into the handle or crashbar whenever possible.
- L. Provide UTC Interlogix RCR-REX.
  - 1. Or equivalent.

## 2.07 Electrified Hardware (EH)

- A. The Security Contractor shall be responsible for the connection of all electrified hardware to the access control system. This shall include providing centralized power supplies located next to or integral to the access control panels. The Contractor shall coordinate with the door hardware specifications and schedules for additional information.

## 2.08 Cables

- A. Provide cabling per manufacturer’s recommendations and code requirements for riser rated, plenum, and non-plenum cable types.
- B. Cables for electronic access-controlled doors shall be bundled and include the followings conductor counts:

1. Card reader – 6 conductor, 22 awg shielded.
  2. Lock power – 4 conductor, 18 awg unshielded.
  3. Door contact – 2 conductor, 22 awg unshielded
  4. Request to exit and/or latch detection/spare – 4 conductor, 22 awg unshielded
- C. Manufacturer:
1. Belden #658AFS
  2. Convergent #725116
  3. General Cable #4EPL1S
  4. Or equivalent
- D. Cables for RS-485 shall be 24-AWG, 2-pair with 100% coverage aluminum foil shield and 90% coverage outer tinned copper braid shield.
1. Manufacturer:
    - a. Belden #9843
    - b. Or equivalent

### **Part 3 - Execution**

#### **3.01 Programming**

- A. The Contractor shall provide all necessary programming to bring new panels, doors and other connected devices into the existing access control system.

#### **3.02 ADA Power Assist Door Operator Interface**

- A. Certain electric locking mechanisms with card access shall be connected (hardwired) to the ADA Power Assist Door Operator pushbutton. In this scenario, card reader shall be interfaced to the ADA Door Operator pushbutton to approve activation of door motor based on card authorization or pre-programmed security schedule.
- B. Door motor shall not be energized until authorized by the security system to prevent operation and eventual burn-out of the motor from hitting the button with the security system activated.
- C. Contractor shall provide all necessary hardware, interfaces, and system programming.

#### **3.03 Fire Alarm Interface**

- A. Certain electric locking mechanisms shall be connected (hardwired) to the building fire alarm system for fail safe release upon any fire alarm. A single low voltage/low current normally closed dry contact from the fire alarm system shall be provided by



others in each room with Security Control Panels. This contact shall open on any fire alarm condition.

- B. The Contractor shall provide all additional UL listed failsafe relays and power supplies as necessary to interface to this contact and unlock all of these doors.
- C. The Contractor shall verify fail safe and fail secure locking requirements with the Architect, door hardware contractor/provider and the AHJ. Refer to fire alarm contractor shop drawing for fire alarm interface requirements.

#### 3.04 Testing

- A. Refer to Section 28 00 00 for additional requirements.
- B. Prior to energizing or testing the system, ensure the following:
  - 1. All products are installed in a proper and safe manner per the manufacturer's instructions.
  - 2. Dust, debris, solder, splatter, etc., is removed.
  - 3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 4. All products are neat, clean, and unmarred, and parts are securely attached.
- C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

#### 3.05 Warranty

- A. Refer to Section 28 00 00 for additional requirements.

#### 3.06 Installation Practices

- A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.
- B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.
- C. Contractor is responsible for providing a complete system.
- D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or

as indicated in their published literature, unless specifically noted herein to the contrary.

- E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

### 3.07 Aesthetics

- A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.
- B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.
- C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.
- D. All surface-mounted devices shall be firmly secured level and plumb
- E. All rack mount equipment shall be securely installed.

### 3.08 Hardware Layout

- A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

### 3.09 Server Installation Practices

- A. Verify that the manufacturer approved server hardware, OS meets the Owner's IT standards prior to ordering.
- B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.
- C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

### 3.10 Device Cabling/Wiring Installation Practices

- A. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.
- B. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed

unacceptable by the Owner shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.

- C. Contractor shall make every effort to conceal wiring.
- D. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.

### 3.11 Cable Termination

- A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

### 3.12 System Inspection

- A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.
- B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

### 3.13 Labeling

- A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

### 3.14 Documentation

- A. Upon completion of the installation, Contractor shall provide full documentation sets to the Owner for approval as described in section 28 05 00. All documentation shall become the property of the Owner.
- B. Documentation shall include the additional specific items detailed in the subsections below:
  - 1. Contractor shall provide hard copy and electronic forms of the final test results.
  - 2. Contractor shall provide a document including the following:
    - a. Door label/identifier
    - b. Location of each drop by orientation/permanent landmark in the room
    - c. Contractor shall provide accurate as-built Construction Drawings.

### 3.15 Pre-Check out

- A. The Contractor shall demonstrate the following to Owner during system demonstration.

1. The card readers are fully installed and functional.

3.16 Final Acceptance

- A. In addition to closeout requirements in section 28 05 00, This Contractor shall demonstrate the following before final approval.

1. Punch list items are complete.
2. As-built documentation is complete and submitted to Owner.

3.17 Final Procedures

- A. Perform final procedures in accordance with section 28 05 00.

**End of Section**

## Section 28 20 00 – Video Surveillance System

### Part 1 - General

#### 1.01 Scope

- A. This specification section covers the furnishing and installation of a new and complete expansion to the existing enterprise-wide, low-voltage, Video Management System (VMS).
- B. Contractor shall furnish and install cameras, mounting brackets, power supplies and other components of the system as shown, specified and required.
- C. Contractor shall furnish and install related software to allow this system expansion. Software includes required licensing addition for cameras and client licenses, workstations and required physical security system Integration.
- D. Furnish and install outlets, power connections, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. The Contractor shall sub-contract an electrician as necessary.
- E. Refer to Section 28 00 00 for additional project scope information.

#### 1.02 Precedence

- A. Obtain, read and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

#### 1.03 Related Work

- A. Section 28 00 00 – General Technology Requirements
- B. Section 28 05 00 – Physical Security General Requirements
- C. Section 28 10 00 – Electronic Access Control System

#### 1.04 Definitions

- A. Refer to Section 28 00 00 for additional definitions.

#### 1.05 Reference Standards and Codes

- A. Refer to Section 28 00 00 for additional requirements.

#### 1.06 Qualifications

- A. The system programmer shall have attended manufacturer training and obtained certification in Genetec Security Center - Omnicast Technical Certification

- B. Optionally, the system programmer shall have attended manufacturer training and obtained certification in Genetec Security Center - Enterprise Technical Certification.
  - C. The system programmer shall be a Genetec certified partner with one of the following levels of qualifications:
    - 1. Certified Reseller or up
    - 2. Elite Reseller or up
    - 3. Unified Elite Reseller
  - D. The system programmer shall submit proof of certifications.
  - E. Refer to Section 28 00 00 for additional requirements.
- 1.07 Pre-Construction Submittals
- A. Refer to Section 28 00 00 for additional requirements.
- 1.08 Construction Progress Submittals
- A. Refer to Section 28 00 00 for additional requirements.
- 1.09 Closeout Submittals
- A. Refer to Section 28 00 00 for additional requirements.
- 1.10 General Summary
- A. System installation shall include, but not be limited to programming, and configuration of system components as well as all associated software upgrades, patches, and maintenance for the first year.
- 1.11 Code and Standard Requirements
- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association and any other codes as required by the AHJ.
  - B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

## Part 2 - Products

### 2.01 VMS General Requirements

- A. The College is currently on a Genetec Security Center Omnicast Enterprise system. The current version is 5.7 SR2. The system id is: GSC-180411-221663. Provide all licensing required to expand the system to accommodate this project.

## 2.02 Mapping Software

- A. The VMS software shall be provided with native integrated mapping software. The Contractor shall include all necessary labor to create and map the devices.
- B. The Contractor shall provide a satellite level screen shot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building then floor plan.
- C. The maps shall have links to the other levels/sections as well as the global map.
- D. All cameras shall show their approximate field of view.
- E. The cameras shall change state when motion is detected.
- F. The floor plans shall include all access controlled doors and integrated devices.
- G. The Contractor shall be responsible to provide all the labor to setup these maps and place all the devices.
- H. The Contractor shall get sign-off from the Owner on the finished maps.
- I. The mapping shall be licensed as necessary to add all devices including access controlled door to the maps.
- J. The Contractor shall obtain the building plans for their use.

## 2.03 Software House Integration

- A. The VMS has been licensed to integrate with the existing Software House CCure 9000 system. The Contractor shall integrate all access controlled devices associated with this project.

## 2.04 VMS Servers

- A. VMS Directory Servers
  - 1. The primary and failover server are existing and installed on virtual servers.
- B. VMS Short-Term Archiver Server
  - 1. The BCD Video short-term archiver servers are existing and currently sized to accommodate this project.
- C. VMS Archiver Long-Term Recording NAS
  - 1. The Veracity Coldstore (CSTORE15-3U-DU-US) long term archiver NAS are existing and currently sized to accommodate this project.

## 2.05 VMS Video Storage

- A. Provide a minimum of eight (8) days of short term server storage calculated at the following resolution and rates. Provide all hardware, software and configuration needed to accomplish this.
  - 1. The system shall be enabled for an automatic video archive transfer to long term storage at 7 days.
- B. Provide a minimum of twenty-four (24) days of long term NAS storage calculated at the following resolution and rates. Provide all hardware, software and configuration needed to accomplish this.
- C. The system shall maintain a total of 30 days of storage with automatic cleanup at 31 days.
- D. Pre and post record buffer of 5 seconds.

## 2.06 VMS Web and Mobile Server

- A. The Web and Mobile servers are existing and installed on a virtual server.

## 2.07 VMS Video Streaming

- A. All cameras shall have the following VBR streams configured. If a camera is not capable of the quantity of streams listed below when they shall be set or order of stream number until the maximum streams are hit.
  - 1. Stream 1 (Record and High Resolution)
    - a. Rates as specified above in VMS video storage (full resolution)
    - b. RTP/TCP
    - c. Multicast (best available)
    - d. Smart codec enabled at a medium setting with a dynamic GoP of up to 4 seconds.
    - e. Stream 1 shall always and only be used for recording.
  - 2. Stream 2 (Live)
    - a. 10 frames per second
    - b. Half resolution
    - c. Multicast (best available)
    - d. H.264
    - e. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.



- f. 1 key frame per second
  - g. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)
3. Stream 3 (Low Resolution)
- a. 10 frames per second
  - b. Quarter resolution
  - c. Multicast (best available)
  - d. H.264
  - e. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.
  - f. 1 key frame per second
  - g. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)
4. Stream 4 (Remote/Mobile Client)
- a. 4 frames per second
  - b. MJPEG
  - c. 640x480 resolution or lowest resolution possible if camera cannot go as low as 640x480. Coordinate resolution requirements with Owner and available bandwidth.
  - d. 512 Kbps data rate cap or as appropriate based on available bandwidth
  - e. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

#### 2.08 Cameras and Devices

- A. All cameras and devices shall be time synced to the Owner's NTP server. Coordinate with the Owner to acquire the appropriate NTP address to use.
- B. The contractor shall coordinate with the owner for IP addressing, network configuration, QoS and multicast network configuration.
- C. The Contractor shall enable QoS on all cameras and intercoms for the video stream, audio stream, event/alarm data, management and metadata at the Owners request.
- D. The system shall be configured for multicast. All cameras shall have a multicast Time To Live (TTL) setting of at least 64.
- E. All cameras shall have the latest VMS recommended firmware installed and all cameras of the same model shall have matching firmware versions. The Contractor

shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project the Owner shall have the option to receive a final firmware update the latest version before the project is paid in full.

- F. All cameras regardless of manufacturer/model shall have a consistent user name and strong non-standard password set. This shall be documented and provided to the Owner prior to inspections.
- G. The cameras shall be verified to be compatible with the Owner's current software version before purchasing. Bring any version compatibility discrepancies to the attention of the Owner.
- H. Camera Type 1 shall:
  - 1. Be designed to provide at least four video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.264 and MJPEG.
  - 2. Native resolution of 1920x1080 pixels.
  - 3. Support the following video resolutions: 1920x1080, 1280x720, 640x360, 320x180, 160x90
  - 4. Provide both 4:3 and 16:9 aspect ratios.
  - 5. 3-10.5 mm lens @ F-stop 1.4.
    - a. Minimum horizontal view angle 92°-34°
  - 6. Be equipped with a high-quality varifocal lens, provide automated iris functionality with provide remote focus functionality.
  - 7. Mechanical day/night IR cut filter.
  - 8. Provide pictures down to 0.16 lux while in day mode (with IR-filter in use) and down to 0.03 lux while in night mode (with IR-filter removed).
  - 9. Be equipped with true multi-frame wide dynamic range (WDR) of at least 120dB at maximum native resolution.
  - 10. Minimum IP66 and IK10 ratings (Exterior model) and Minimum IP52 and IK08 ratings (Interior model).
  - 11. Camera shall provide modern bit rate reduction technology. Such as Axis Zipstream technology.
  - 12. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
  - 13. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party

applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.

14. Provide the ability to adjust the camera modules angle with at least 180° pan, 80° tilt and 95° rotation while maintaining an image that is not interfered with by the camera housing.
15. IEEE 802.1X (Authentication) compliant.
16. Manufacturer and model:
  - a. Interior Location - Axis P3225-LV MK II
  - b. Exterior Location – Axis P3225-LVE MKII
  - c. Or equivalent

#### 2.09 Camera Management Tools

- A. The Contractor shall add all new cameras to the Owner’s existing Axis camera management tool installed on a virtual server. Update the tool to the latest version as necessary.

#### 2.10 Ethernet with Power over Ethernet (PoE) UTP Surge Suppressor

- A. The Contractor shall provide and install a surge protector for all exterior mounted cameras. Cameras that are not attached to the building or reach above the building roof line shall have a surge protector at the camera side and interior termination side.
- B. There shall be a minimum of a 36” shielded patch cable from the surge protector to the device to allow for adequate clamping time.
- C. When protector is mounted in interior, dry or weather sealed enclosure:
  1. Shielded RJ-45 jacks and ground stud
    - a. Connect ground directly to ground bar (TMGB/TGB) or ground.
    - b. Do not use shielded cable on the output.
  2. Maximum supported data rate: 10,000Mb/s (10 Gigabit)
  3. Supports IEEE 802.3af (PoE)
  4. Max current rating of 30A per pair.
  5. UL 497B listed
  6. 110 punch down in and 110 punch down out.
    - a. 110 punch down in and RJ-45 out may be used when output is connected directly to a switch only when approved in specific situations.

7. Manufacturer:
  - a. Ditek DTK-110C6APOE
  - b. Or approved equal
- D. When protector is exposed to weather or moisture:
  1. Shielded RJ-45 jacks and ground connection.
    - a. Connected ground connection directly to ground.
    - b. Do not use shielded cable on the output.
  2. Outdoor-rated NEMA 4X enclosure
  3. Maximum supported data rate: 1,000Mb/s (1 Gigabit)
  4. Supports IEEE 802.3af, 802.3at (PoE) and PoE+ up to 144 watts per port.
  5. Max current rating of 20,000A per pair.
  6. UL 497B listed
  7. RG-45 in and RJ-45 out.
  8. Provide with appropriate mounting kit.
  9. Manufacturer:
    - a. Ditek DTK-MRJPOEX
    - b. Or approved equal

### **Part 3 - Execution**

#### **3.01 Integration with Physical Security Systems**

- A. The video surveillance system shall be integrated with the Physical Security Systems via an Ethernet interface with the minimum follow features.
  1. Graphical floor plan maps showing icons of all cameras and other integrated systems such as access control.
  2. There shall be (2) cameras associated/integrated with each door.
  3. Camera views linked to other camera views for seamless tracking of a subject throughout a facility.
  4. Device names brought in from the integrated systems.
  5. Database entries for all actions performed.
  6. Time syncing via common NTP server.

- B. The Contractor shall provide any and all licensing to integrate the systems together including any additional items to be added to the yearly maintenance agreement.
- C. Refer to the individual specification sections for additional specific integration requirements.
- D. The Contractor shall set up a meeting between the Owner and manufacturer to determine the exact functionality of the integration before the integration starts.

### 3.02 Coordination

- A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with camera aiming, additional programming or other duties requested by Owner.

### 3.03 Testing

- A. Refer to Section 28 00 00 for additional requirements.
- B. Prior to energizing or testing the system, ensure the following:
  - 1. All products are installed in a proper and safe manner per the manufacturer's instructions.
  - 2. Dust, debris, solder, splatter, etc., is removed.
  - 3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 4. All products are neat, clean, and unmarred, and parts are securely attached.
- C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

### 3.04 Warranty

- A. Refer to Section 28 00 00 for additional requirements.

### 3.05 Installation Practices

- A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.
- B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.

- C. Contractor is responsible for providing a complete and functional turn-key video surveillance system.
- D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or as indicated in their published literature, unless specifically noted herein to the contrary.
- E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

### 3.06 Aesthetics

- A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.
- B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.
- C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.
- D. All surface-mounted devices shall be firmly secured level and plumb
- E. All rack mount equipment shall be securely installed.

### 3.07 Hardware Layout

- A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

### 3.08 VMS Installation Practices

- A. Verify that the manufacturer approved server hardware, Operating System meets the Owner's IT standards prior to ordering.
- B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.
- C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

### 3.09 Device Cabling/Wiring Installation Practices

- A. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.

- B. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.
- C. Contractor shall make every effort to conceal wiring.
- D. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.
- E. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.
- F. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.
- G. No splices shall be installed in any cable.

#### 3.10 Cable Termination

- A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

#### 3.11 System Inspection

- A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.
- B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

#### 3.12 Labeling

- A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

#### 3.13 Documentation

- A. Upon completion of the installation, Contractor shall provide full documentation sets to the Owner for approval as described in section 28 05 00. All documentation shall become the property of the Owner.
- B. Documentation shall include the additional specific items detailed in the subsections below:
  - 1. Contractor shall provide hard copy and electronic forms of the final test results.

2. Contractor shall provide a document including the following:
  - a. Camera label/identifier
  - b. Location of each drop by orientation/permanent landmark in the room
  - c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

#### 3.14 Final Acceptance

- A. In addition to closeout requirements in section 28 05 00, This Contractor shall demonstrate the following before final approval.
  1. Owner training (as required) is complete.
  2. Punch list items are complete.
  3. As-built documentation is complete and submitted to Owner.

#### 3.15 Final Procedures

- A. Perform final procedures in accordance with section 28 05 00.

**End of Section**



**SECTION 284600 - FIRE DETECTION AND ALARM**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire-alarm control panels.
- B. The intent of this project is to provide all labor equipment and materials to replace existing control panels with the specified equipment and fully integrate devices and equipment at the facility in order to provide a fully functional fire alarm system.

1.2 REFERENCE STANDARDS

- A. National Fire Protection Association:
  - 1. NFPA 72 - National Fire Alarm and Signaling Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- B. UL:
  - 1. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.

1.3 COORDINATION

- A. Coordinate Work of this Section with Work of other Sections.

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information showing electrical characteristics and connection requirements.
- B. Shop Drawings:
  - 1. Indicate system wiring diagram showing each device and wiring connections.
  - 2. Indicate annunciator layout.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for fire-alarm system.

- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports:
  - 1. Certify that equipment has been installed according to manufacturer instructions.
  - 2. Indicate activities on Site, adverse findings, and recommendations.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of fire-alarm equipment.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials:
  - 1. Furnish six keys of each type provided.

1.8 QUALITY ASSURANCE

- A. Perform Work according to NFPA Standards and NEC.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.
- C. Before commencing work, submit evidence showing that the equipment installer has successfully installed systems of the similar scope, type and design as specified. The contractor/installer shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction. The contractor/installer shall be responsible for retaining qualified and authorized representative(s) of the system manufacturer specified for detailed system design and documentation, coordination of system installation requirements, and final system testing and commissioning in accordance with these specifications. The contractor/installer shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Fire-Alarm System:
  - 1. The system shall be a new UL Listed modular fire alarm network that uses independently addressed fire detection devices, input/output control modules, and notification appliances.
  - 2. The network shall utilize token ring, peer-to-peer communications. The network shall consist of a main panel and remote control panels. To enhance survivability, each panel shall be an equal, active functional member of the network, capable of making all local decisions and initiating network tasks for other panels. In the event of a panel failure or communications failure between panels, panels shall be capable of forming sub-networks and remain operational between communicating panels. Master/slave system configurations shall not be considered as equal.
  - 3. The system shall be fully field programmable such that virtually any combination of system output functions may be correlated to any type of input event(s). Inputs may be combined using Boolean logic, be time dependent or under manual control, as defined by required system operation. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panels. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.
  - 4. Addressable smoke detector sensitivity settings for both pre-alarm and alarm activation shall be automatically individually configurable for both daytime and nighttime operation. Addressable smoke detectors shall be UL listed for automatic sensitivity testing.
  - 5. Ease of maintenance shall be facilitated by the use of panel based and PC based system diagnostics.
    - a. The system shall automatically test smoke detector sensitivity, eliminating the need for manual sensitivity testing.

- b. Ground fault detection and annunciation shall be by individual module address for supervised input and output devices.
  - c. System test operation shall be configurable by individual addressable devices, and not disable entire circuits.
  - d. The system shall be capable of generating a graphical map of connected all addressable devices to aide in circuit troubleshooting.
  - e. Placement supervision of addressable devices shall couple a device's location (not its address) to the programmed system response.
6. The system shall be designed, inspected, tested and approved to provide occupant notification audibility levels of 15 dBA over ambient conditions.
  7. The system shall support CO and security detection devices with appropriate independent annunciation and signal processing.
  8. The system shall interface with other building systems as required by the fire codes.
  9. The system shall transmit required signals to a central monitoring station.
  10. System panels and annunciators shall utilize configurable message routing and selective event messaging to direct event information only to the required system displays and printers as determined by the event type and location.
  11. The existing fire alarm shall be removed and new control panels, power supplies and related equipment shall be installed as specified.
  12. Where existing devices are not addressable or where annunciating equipment is not compatible with the new fire alarm, accommodations shall be made as necessary to use the existing devices and annunciators as a temporary measure. A future phase of construction will replace such devices and annunciators to be compatible with the system described herein.
- B. Comply with the provisions of NFPA 72 and the operational requirements of this specification.
- C. The system shall identify all off normal conditions and log each condition into the system as an event.
1. The system shall automatically display on the control panel Liquid Crystal Display (LCD) the first (oldest) event of the highest priority by type. The event priority shall be alarm, supervisory, trouble, and monitor.
  2. The system shall utilize four event queues, and shall not require event acknowledgment by the system operator. Labeled, color coded indicators shall be provided for each type of event queue: alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
  3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.
  4. The user shall be able to review each event queue by simply selecting scrolling keys (up-down) for the event type.
  5. New alarm, supervisory, or trouble events shall sound a distinct, silenceable audible signal at the control panel.
  6. The LCD shall show the number of active alarm, supervisory, trouble and monitor events
  7. The LCD shall show the system time and the number of active and disabled points in the system.
  8. Specific input/output devices shall operate in accordance with the alarm, supervisory, trouble, monitor sections that follow and the input/output matrix.
- D. All critical systems, sub-systems and circuits shall be monitored for integrity. System faults shall be annunciated.

- E. Strobes shall be synchronized on each floor.
- F. Batteries shall be sized to support the system for <24 Hrs. of standby operation followed by 5 minutes of alarm operation at the end of the 24 Hour period.> <24 Hrs. of standby operation followed by 15 minutes of alarm operation at the end of the 24 Hour period. >
- G. Off premises reporting of the loss of AC mains power to any system component shall be automatically delayed for a period of time acceptable to the AHJ to reduce traffic at the central monitoring station due to wide-area power failures.
- H. The system shall provide configurable service groups to facilitate "one man" testing of the system based on the physical layout of the building. Each service group shall be capable of supporting any combination of system devices, independent of the circuit on which they are installed. Systems that disable entire circuits, circuits serving multiple floors or fire zones for testing shall not be considered as equal. Activated devices on a service group shall be capable of initiating alternative system test responses to facilitate system maintenance and minimizing occupant disturbances while in test mode.
- I. Event processing and display shall be prioritized as follows:
  - 1. Fire alarms
  - 2. Supervisory events
  - 3. Trouble events
  - 4. Monitor events
- J. Alarm Operation:
  - 1. Upon the alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow, duct smoke detector or other initiating device, the following functions shall automatically occur:
    - a. The system shall remain in the alarm mode until all initiating devices are reset and the fire alarm panel is manually reset and restored to normal.
    - b. The internal audible device shall sound at the control panel or command center.
    - c. Display the alarm event on the graphical workstation.
    - d. The LCD display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.
    - e. All system activity/events shall be documented on the system printer and logged into system history.
    - f. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
    - g. Activate notification audible appliances.
    - h. Activate visual strobes notification appliances. The visual strobe shall continue to flash until the system has been reset.
    - i. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.
  - 2. Audible alarm signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
  - 3. Any notification appliance dedicated to a sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
  - 4. Transmit signal to the building automation system where appropriate.
  - 5. Transmit signal to the central monitoring station with point identification.

K. Supervisory Operation

1. Upon supervisory activation of any supervisory switch, off-normal indication or system trouble, the following functions shall automatically occur:
  - a. The internal supervisory event audible device shall sound at the control panel.
  - b. Display the event on the graphical workstation and display a pictorial image.
  - c. The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
  - d. All system activity/events shall be logged to system history.
  - e. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
  - f. Transmit signal to the central monitoring station with point identification.

L. Trouble Operation

1. Upon activation of a trouble condition or signal from any device or internal system integrity monitoring function on the system, the following functions shall automatically occur:
  - a. The internal panel audible device shall sound at the control panel.
  - b. Display the event on the graphical workstation and display a pictorial image.
  - c. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
  - d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not prevent the logging of trouble events to the historical file.
  - e. All system activity/events shall be logged to system history.
  - f. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
  - g. Transmit a trouble signal to the central monitoring station with point identification.

M. Monitor with Security Operation

1. Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:
  - a. The internal panel audible device shall sound at the control panel.
  - b. The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
  - c. All system activity/events shall be logged to system history.
  - d. Any remote or local annunciator LCD/LED's associated with the status monitor circuit be illuminated.
2. Security Events:
  - a. Display at the local fire alarm control panel graphic LCD display, the origin of the security condition. A dedicated security LED shall flash until the alarm has been acknowledged, then revert to a steady "ON" state.
  - b. The system shall be capable of bypassing the alarms from an individual security points installed within selected areas. The pass code activation this function shall be assignable to individual security personnel and

each bypass action shall be logged to system history. Intrusion alarms occurring during a bypass period shall be logged to history and displayed but no audible alarm shall occur at the control panel.

## 2.2 CONTROL PANELS

### A. Manufacturer and Model:

1. Edwards EST3
2. Panels must be fully compatible with existing sensors, initiating and indicating (signaling) devices. Panels must be fully compatible with other existing panels. Panels must be capable for communication with all other existing panels.
3. All materials, equipment, accessories, devices and other facilities and appurtenances covered by these specifications or noted on the drawings shall be new, best suited for the intended use and shall conform to applicable and recognized standards for their use and supplied by a single manufacturer. Should any equipment provided under this specification be supplied by a different manufacturer, that equipment shall be recognized compatible by BOTH manufacturers and listed as such as required by Underwriters' Laboratories.

### B. Description:

1. Modular fire-alarm control panel, with flush or surface wall-mounted enclosure to match existing.
2. The fire alarm control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio communications, smoke control and guard patrol applications. The control panel shall be listed and approved for the application standard(s) as listed in the References section of this specification.
3. The control panel shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured and modified using software provided by the manufacturer. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.
4. The operating controls shall be located in a dead-front steel enclosure behind a locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. All panel modules shall be placement supervised for and signal a trouble if damaged or removed.

### C. System Features:

1. Each control panel shall include the following capabilities:
  - a. Supervision of the system electronics, wiring, detection devices and software
  - b. Up to 2500 analog/addressable input/output points
  - c. Network connections with up to 63 other control panels and annunciators.
  - d. Support multiple dialers (DACTs) and modems
  - e. Two communication ports
  - f. An internal audible signal with different patterns to distinguish between alarm, supervisory, trouble and monitor events
  - g. Support multiple 24 VDC and Audio NACs
  - h. User configurable switches and LED indicators to support auxiliary functions

- i. Log up to 1740 chronological events
- j. The ability to download all applications and firmware from the configuration computer at a single location on the fire network
- k. A real-time clock for time stamps and timed event control
- l. Electronic addressing of intelligent addressable devices
- m. Provide an independent hardware watchdog to supervise software and CPU operation
- n. "Dry" alarm, trouble and supervisory relay contacts
- o. Control panel modules shall plug in to a chassis assembly for ease of maintenance
- p. Field wiring shall connect to the panel using removable connectors

D. User Oriented Features:

- 1. Each control panel shall include the following user oriented features:
  - a. An LCD user interface control/display that shall annunciate and control system functions.
  - b. Provide discreet system control switches for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details.
  - c. A "lamp test" feature shall verify operation of all visual indicators on the panel.
  - d. An authorized user shall have the ability to operate or modify system functions including system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
  - e. An authorized user shall have the ability to disable/enable devices, zones, actions, timers and sequences.
  - f. An authorized user shall have the ability to activate/restore outputs, actions, sequences, and simulate detector smoke levels.
  - g. An authorized user shall have the ability to enter time and date, reconfigure an external port for download programming, initiate programming and change passwords.
  - h. An authorized user shall have the ability to test the functions of the installed system.
  - i. Service groups shall facilitate one-man walk testing. Service/test groups shall be capable of being configured with any combination of addressable devices, independent of SLC wiring. It shall be possible to program alternate device responses when the device's service group is active. Devices not in an active service group shall process all events normally.
  - j. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
  - k. SLC loop controller diagnostics shall identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the supervised circuit wiring of remote addressable modules shall be identified by device address.
  - l. An authorized user shall have the ability to generate a report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity.
  - m. System reports shall provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.



- n. An authorized user shall have the ability to display/report the condition of addressable analog detectors. Reports shall include device address, device type, percent obscuration, and maintenance indication. The maintenance indication shall provide the user with a measure of contamination of a device upon which cleaning decisions can be made.

E. Programmability

- 1. A Windows-based Configuration Utility (CU) shall be used to create the site-specific system programming. The utility shall facilitate programming of any input point to any output point. The utility shall allow customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms.
  - a. Zoning of initiation devices.
  - b. Initiation of events by time of day, day of week, day of year.
  - c. Initiation of events by matrix groups (X-Y coordinate relationships) for releasing systems.
  - d. Initiation of events using OR, AND, NOT and counting functions.
  - e. Prioritizing system events.
  - f. Programmable activation of detector sounder bases by detector, groups of bases, or all bases.
  - g. Directing selected device messages to specific panel annunciators
  - h. Detector sensitivity selection by time of day
  - i. Support of 256 Central Monitoring Station accounts and directing selected device messages to any one of ten Central Monitoring Stations.
- 2. The configuration utility shall time and date stamp all changes to the site-specific program and shall facilitate program versioning and shall store all previous program version data. The utility shall provide a compare feature to identify the differences between different versions of the site-specific program.
- 3. The configuration utility shall be capable of generating reports which detail the configurations of all fire alarm panels, addressable devices and their configuration settings including generating electrical maps of the addressable device SLCs.
- 4. The configuration utility shall support the use of bar code readers to expedite electronic addressing and custom programming functions.

F. Power Supply:

- 1. System power supply(s) shall be a high efficiency switched mode design providing multiple supervised power limited 24 VDC output circuits as required by the panel and external loads fed by the panel. Initial power supply loading shall not exceed 80% of power supply capacity in order to allow for future system expansion.
- 2. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
- 3. It shall be possible to parallel system power supplies to increase capacity or to provide redundant operation.
- 4. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functionality.
- 5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
- 6. All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic load test of batteries and

indicate a trouble condition if the batteries fall outside a predetermined range. Power supplies shall incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. The power supply shall automatically disconnect the battery before low voltage damages the battery. Low battery and disconnection of battery power supply conditions shall be immediately annunciated as battery trouble and identify the specific power supply(s) affected.

7. Batteries shall utilize sealed lead acid chemistry. Initial battery capacity shall provide 125% of calculated capacity requirements in order to allow for future system expansion.
8. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 70 and NFPA 72. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside each control panel the disconnect serves.

G. Panel LCD and Common Controls

1. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the facility.
2. Each fire alarm control panel (system node) shall be capable of supporting a backlit LCD display. The display on each system node shall be configurable to display the status of any and/or all combinations of all alarm, supervisory, trouble, monitor, or service group event messages on the network. Each LCD display on the system shall be capable of being programmed to allow control functions of any combination of nodes on the entire network. The system shall support both 168-character and 960-character LCD displays on the same network.
3. The LCD display shall provide separate alarm, trouble, supervisory, and monitor event queues of to minimize operator confusion. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
4. The LCD display shall contain the following system status indicators:
  - a. System Power Indicator
  - b. System Test Indicator
  - c. System CPU Fail Indicator
  - d. Ground Fault Indicator
  - e. Disabled Points Indicator
  - f. System Normal Indicator
  - g. System Common Alarm Indicator
  - h. System Common Trouble Indicator
  - i. System Common Supervisory Indicator
  - j. System Common Monitor Event Indicator
5. The LCD display shall contain the following system switch/indicators:
  - a. System Reset Switch with Indicator
  - b. System Alarm Silence Switch with Indicator
  - c. System Panel Silence Switch with Indicator
  - d. Drill Switch with Indicator
  - e. Alarm Acknowledge Switch with Indicator
  - f. Trouble Acknowledge Switch with Indicator
  - g. Supervisory Acknowledge Switch with Indicator
  - h. Monitor Acknowledge Switch with Indicator
6. The LCD display shall contain the following system function switches
  - a. System Event Message Queue Scroll Switch.

- b. Event Details Switch (provides an additional 2000-character message about the device highlighted by the operator.)
- c. Command Menu Switch
- d. 10-Digit Keypad with Enter and Backspace switches

H. Fire Network Wiring

- 1. The network media shall be fiber optic cable furnished by the owner
- 2. The system shall utilize node to node, direct wired peer-to-peer network operations. The system shall be configured to utilize independently addressed modules. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between nodes.
- 3. Existing network media will not be replaced under this contract. In the event that the existing media or portions of the existing network are not fiber, component shall be included in the alarm panel to accommodate existing network media and to be convertible to fiber-optic media in the future.

I. EST3 System

- 1. All signaling line circuits shall be supervised and power limited.
- 2. When the addressable devices on a signaling line circuit cover more than one designated fire/smoke compartment, a wire-to-wire short on the circuit shall not affect the operation of the addressable devices in other fire/smoke compartments.
- 3. Each SLC shall support 125 addressable detector addresses and 125 module addresses. The SLC shall support 100% of all addressable devices in alarm and provide support for a 100% compliment of detector isolator bases. Initial circuit loading shall not exceed 80%, to allow for future system expansion.
- 4. The addressable device SLC module shall be UL Listed for use with code compliant, electrically sound existing wiring.
- 5. Each intelligent addressable device shall transmit information about its location with respect to other devices on the circuit. This information shall be used to create an "As-Built" wiring diagram as well as provide enhanced supervision of a device's physical location. The device message and programmed system output function shall be associated with the device's location on the SLC circuit location and not a device address.
- 6. The SLC module shall allow replacement of "same type" devices without the need to address and reload the "location" parameters on replacement device.
- 7. The SLC/Panels shall notify the user when programmed devices are detected on the SLC circuit. The SLC/Panels shall notify the user when the wrong device type is installed at a location configured for a different device type on the SLC circuit. Should an SLC Controller CPU fail to communicate, the SLC circuit shall go into the stand-alone mode. The circuit shall be capable of producing a loop alarm if an alarm type device becomes active during stand-alone mode to enhance system integrity.

J. Initiating Device Circuits:

- 1. Furnish supervised zone module with alarm and trouble indication compatible with existing devices.

2. Devices are not to be replaced.
- K. Indicating Appliance Circuits:
1. Furnish supervised signal module, sufficient for signal devices connected to system.
  2. Occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.
  3. Indicating Appliances are not to be replaced.
- L. DACT
1. The system shall provide off premises communications capability using a Digital Alarm Communications Transmitter (DACT) for sending system events to multiple Central Monitoring Station (CMS) receivers over conventional telephone lines.
  2. The system shall provide the CMS(s) with point identification of system events using 4/2, Contact ID (SIA DC-05) or SIA DCS protocols.
  3. The dialer shall support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system design.
  4. In the event of a fire alarm panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.
  5. The owner shall arrange for two (2) dedicated loop-start phone lines to be terminated using two RJ31X jacks within 5 ft of the main fire alarm control panel.
- M. Surge Suppression Devices
1. The system shall utilize the following electrical surge protection devices to prevent damage and nuisance alarms caused by nearby lightning strikes, stray currents, or voltage transients.
  2. On the AC Input of all fire alarm panels, remote power supplies and HPSA sites: Transtector ACO100BWN3, Leviton OEM-120EFI, EFI HWM-120, Ditek DTK-120HW or DTK-120/240 CM. Excess lead length shall be trimmed. The branch circuit conductor shall be formed into a 5-10 turn 1" diameter tie-wrapped coil just downstream of the suppressor connection.
  3. On each DC fire alarm circuit entering or leaving the building: Transtector TSP8601, Citel American B280 -24V, Edco P264 and P642, Ditek DTKxLVL series, or equal.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that products and systems receiving devices are ready for installation.

#### 3.2 PREPARATION

- A. Existing Work:

1. Disconnect and remove abandoned fire-alarm equipment.
2. Access:
  - a. Maintain access to existing fire-alarm equipment and other installations remaining active and requiring access.
  - b. Modify installation or provide access panel.

### 3.3 INSTALLATION

- A. The entire system shall be installed in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams.
- B. All work shall be performed in accordance with the requirements of NFPA 70 and NFPA 72.
- C. Coordinate locations of all devices with all other divisions' drawings and specifications.
- D. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the contract drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer.
- E. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- F. All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems may be installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s) or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.
- G. No wiring except life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures.
- H. Any low-voltage copper wiring that leaves the protection of a building shall be provided with a compatible UL 497B listed transient protection devices where the circuit leaves the building and where it enters the next building.
- I. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled such that removal of the device is not required to identify the EOL device.
- J. Fiber Optic Cable
  1. Only glass filament cable permitted. Plastic filament fiber optic cables are not acceptable.
  2. ST connectors shall be used at all equipment terminations. Consult local building code for mounting height requirements.
- K. Fire Alarm Control Panels:
  1. Mount the enclosure with the top of the cabinet 72" above the finished floor or center the cabinet at 63", whichever is lower.
  2. Label the fire alarm panels with the room number, electrical panel number and circuit breaker number feeding them.

3. Paint the handles of the dedicated circuit breakers feeding fire alarm panels red and install handle locks.
  4. Within the panel, all non-power limited wiring must be properly separated from power limited circuits.
  5. Grounds shall comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
  6. Connect all device conduit and wire to new panel.
- L. Automatic Detector Installation: Comply with NFPA 72.
- M. Install engraved plastic nameplates for each new panel.

### 3.4 FIELD QUALITY CONTROL

- A. Test fire detection and alarm devices and systems according to NFPA 72 and local fire department requirements.
- B. Manufacturer Services: Furnish services of certified manufacturer's representative experienced in installation of products furnished under this Section on Site for installation, inspection, startup, field testing, adjustments, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

### 3.5 DEMONSTRATION AND TRAINING

- A. Testing, general
1. In addition to tests required in this section, the contractor shall perform all electrical and mechanical tests required by the equipment manufacturer, the architect and the authority having jurisdiction.
  2. The contractor shall perform all testing in occupied facilities at times of day that present the lowest impact and disruption to business and activities. Coordinate all testing in occupied buildings with the building owner's representative to assure that fire alarm system testing does not interrupt operations. This may require extensive after hours work to perform such testing.
  3. All equipment, instruments, tools and labor required to conduct the system tests shall be provided by the installing contractor. At a minimum, the following equipment shall be made available testing:
    - a. Ladders and scaffolds as required to reach all installed equipment.
    - b. Meters for reading voltage, current and resistance.
    - c. Two-way communication devices
    - d. Simulated smoke, heat-producing devices for heat detectors, extension poles for introducing smoke into detectors, as needed.

- e. Manufacturer's instruments to measure air flow through duct smoke detectors.
  - f. Decibel meter.
  - g. Status and diagnostic software and PC.
- B. All testing shall utilize a written acceptance test plan for testing the system components and operation in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the acceptance test plan, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and system programming.
- 1. The systems operation matrix created by the equipment supplier shall be used to identify each alarm input and verify all associated output functions.
- C. The system test plan shall include but not be limited to the following:
- 1. Visually inspect all wiring.
  - 2. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final acceptance test.
  - 3. System wiring shall be tested to demonstrate correct system response for the following conditions:
    - a. Open, shorted and grounded signal line circuits.
    - b. Open, shorted and grounded notification appliance circuits.
- D. System indications shall be demonstrated as follows:
- 1. Correct message content for each alarm input at all system displays.
  - 2. Correct annunciator light for each alarm input at each graphic display.
  - 3. Correct history logging for all system activity.
  - 4. Correct sensitivity for all smoke detection devices. The use of system generated sensitivity reports is acceptable in meeting this requirement.
    - a. Correct signals sent to the Central Monitoring Station.
  - 5. Notification appliances shall be demonstrated as follows:
    - a. All alarm notification appliances actuate as programmed
    - b. Audibility and visibility at required levels. Measure sound levels at 5 ft. above finished floor with the room doors closed.
    - c. For 24VDC NACS, measure and record the voltage at the most remote appliance on each notification appliance circuit, while operating.
  - 6. System control functions shall be demonstrated as follows:
    - a. In accordance with the system operation matrix.
  - 7. System off premises reporting functions shall be demonstrated as follows:
    - a. Correct information received for each alarm and trouble event
  - 8. Secondary power supply (battery) capacity capabilities shall be demonstrated as follows:
    - a. System battery voltages and charging currents shall be measured and recorded at the fire alarm control panels.
    - b. System primary power shall be disconnected for 24 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period of 5 minutes.
    - c. System primary power shall be restored for forty-eight (48) hours.
    - d. System battery voltages and charging currents shall again be measured and recorded at the fire alarm control panels.
  - 9. Verify the "As Built" record drawings are accurate.
- E. Preliminary Testing

1. Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of the written test plan. Correct any deficiencies, omissions or anomalies and retest the affected devices to assure proper function per the specification.

F. Acceptance Testing

1. A final acceptance test shall not be scheduled until the system manuals are provided to and approved by the owner and the following are provided at the job site:
  - a. "As Built" record drawings of the system as actually installed
  - b. A copy of the system operation matrix.
2. The acceptance inspector shall use the system "As Built" record drawings in combination with the system operation matrix and the written acceptance test plan during the testing to verify system operation.
3. Should the system not perform to the above criteria it shall not be accepted and the contractor shall correct all deficiencies and shall re-test the system at contractor's expense in the presence of the architect using the same test criteria.
4. The building owner's representative shall witness the final tests.
5. The central monitoring station and/or fire department shall be notified before final test in accordance with local requirements.
6. Operate every installed device to verify proper operation and correct annunciation at control panel.
7. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.

G. Test Reports

1. A "Fire Alarm System Record of Completion" per the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in shall be prepared by the Contractor. Submit three (3) copies to the Architect. The report shall include, but not be limited to:
  - a. A list of all equipment installed and wired.
  - b. Certification that all equipment is properly installed and functions and conforms with these specifications.
  - c. Sensitivity settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
  - d. Technician's name, certificate number and date.

H. Training

1. The system supplier shall schedule and present a minimum of four (4) hours of formal site-specific instruction for each of two people designated by the Owner, detailing the proper operation and maintenance of the installed system.
2. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
3. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.
4. Copies of all training aids, presentations, etc. shall be left with the owner.



- I. System supplier and contractor shall provide a certified test report to verify that the system and all components functioned properly and as intended. A filled-out Record of Completion similar to NFPA 72, 2007 edition figure 4.5.2.1 shall be provided.

**3.6 MAINTENANCE**

- A. The contractor shall warranty the installation and workmanship for one (1) year and all parts for thirty-six (36) months from date of final acceptance. A copy of the manufacturer's warranty shall be provided with closeout documentation and included with the operation and installation manuals. The full cost of maintenance, labor and materials required to correct any defect during the warranty period shall be included in the submittal bid.
- B. During the warranty period, each year the contractor shall perform detector sensitivity testing and provide a report to the owner. If the system is UL Listed to perform automatic detector sensitivity testing without manual intervention, and if a detector falls outside of sensitivity window the system automatically indicates a devices trouble, then this requirement shall be waived. Documentation from UL shall be provided as proof of automatic sensitivity testing operation.
- C. The system supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Provide a telephone response to Owner's questions within 4 hours and on-site assistance within 24 hours.
- D. Permit the Owner's fire alarm technicians to perform temporary bypasses and emergency repairs on the system without voiding the warranty.

END OF SECTION 284600

**SECTION 311000 - SITE CLEARING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Removing surface debris.
  - 2. Removing designated paving, curbs, and sidewalk.
  - 3. Removing designated trees, shrubs, and other plant life.
  - 4. Cutting and Capping utilities.
  - 5. Removing designate site appurtenances.
  - 6. Stripping topsoil.

**1.2 SUBMITTALS**

- A. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

**1.3 QUALITY ASSURANCE**

- A. Perform Work in accordance with local and state standards.

**PART 2 - EXECUTION**

**2.1 EXAMINATION**

- A. Verify conditions before starting work.
- B. Verify underground utilities before starting work.
- C. Verify existing plant life designated to remain is tagged or identified.
- D. Identify waste area for placing removed materials.

**2.2 PREPARATION**

- A. Call Local Utility Line Information service not less than three (3) working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas. If utilities are not marked out by local utility service, engage the services of an underground utility locating service to determine the exact depth and location of existing utilities.

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### 2.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

### 2.4 CLEARING

- A. Clear areas required for access to site and execution of Work to minimum depth of 12 inches
- B. Remove trees and shrubs indicated. Remove stumps.
- C. Clear undergrowth and deadwood, without disturbing subsoil.

### 2.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove paving, curbs, and sidewalks.
- C. Cut and Cap abandoned utilities. Indicate cut and cap locations for underground utilities on Record Documents.
- D. Continuously clean-up and remove 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.

END OF SECTION 311000

**SECTION 31 23 17 - TRENCHING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes excavating and backfill trenches for utilities.

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/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 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).

1.3 SUBMITTALS

- A. 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.
- B. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- C. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- D. Materials Source: Submit name of imported fill materials suppliers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements

1.4 QUALITY ASSURANCE

- A. 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 Jersey

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Structural Fill : as specified in Section 31 05 16

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detour 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.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.

- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe utilities
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. 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.
- J. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.
- K. Trim excavation. Hand trim for bell Remove loose matter.
- L. Remove excess subsoil not intended for reuse, from site.
- M. Stockpile excavated material in area designated on 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. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

#### 3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric over Fill Type prior to placing subsequent fill materials.
- D. Place material in continuous layers not to exceed 8 inches compacted depth.

- E. Employ placement method that does not disturb or damage foundation perimeter drainage utilities in trench.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Do not leave more than 50 feet of trench open at end of working day.
- H. Protect open trench to prevent danger to the public.

**3.6 TOLERANCES**

- A. Top Surface of Backfilling [Under Paved Areas]: Plus or minus 0.5 inches, 0.04 feet from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch, 0.8feet from required elevations.

**3.7 FIELD QUALITY CONTROL**

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. 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.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

**3.8 PROTECTION OF FINISHED WORK**

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312317

**SECTION 31 23 23 - FILL**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes backfilling, backfilling site structures to subgrade elevations, and imported fill.

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/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 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).

1.3 SUBMITTALS

- A. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- B. Materials Source: Submit name of imported fill materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

1.4 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill
  - 1. See Soils for Earthwork
- B. Imported Fill



1. Importation of any fill material for backfill of the excavation sand/or construction shall be pre-approved by the design engineer prior to fill material being imported to the site. Certified clean fill shall be used in excavated areas where structural fill is not being used.
- C. Recycled Concrete for Pool In-fill
  1. Recycled concrete aggregate from the demolition of Building #9 is permitted to be used for the pool in-fill, comprising of 100% crushed concrete. This material shall be free of all masonry, including brick and block, and all other organic material.
  2. Concrete shall be crushed and reprocessed, either on-site or off-site, to a maximum size similar to quarried 2A stone.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify sub-drainage, damp proofing, or waterproofing installation has been inspected.
- B. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- C. Verify structural ability of unsupported walls to support loads imposed by fill.

#### 3.2 PREPARATION

- A. Compact subgrade to 95% modified proctor density requirements for subsequent backfill materials.
- 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 subsequent fill material.
- C. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

#### 3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place geotextile fabric over fill prior to placing next lift of fill.
- D. Place material in continuous layers, maximum 8 inches compacted depth.
- E. Employ placement method that does not disturb or damage other work.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported foundation walls and do not backfill against unsupported foundation walls.
- H. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

- I. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- J. Make gradual grade changes. Blend slope into level areas.
- K. Remove surplus backfill materials from site.
- L. Leave fill material stockpile areas free of excess fill materials.

**3.4 FIELD QUALITY CONTROL**

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. 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.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Proof roll compacted fill surfaces under slabs-on-grade, pavers, and paving.

**3.5 PROTECTION OF FINISHED WORK**

- A. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION 312323

**SECTION 32 11 23 - AGGREGATE BASE COURSES**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes aggregate base course for use under concrete and asphalt paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
- B. ASTM International:
  - 1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  - 2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 4. ASTM D2940 - Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
  - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Product Data:
  - 1. Submit data for geotextile fabric and herbicide.
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of aggregate fill to testing laboratory.
- C. Materials Source: Submit name of aggregate 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 NJDOT Standard Specifications for Road and Bridge Construction, Section 302, as currently amended.
- C. Maintain once copy of each document on site.

**PART 2 PRODUCTS**

**2.1 AGGREGATE MATERIALS**

- A. Base Aggregate shall comply with stone aggregate Type I-5 of the NJDOT Standard Specification for Road and Bridge Construction, Section 901.10 & 901.11, as currently amended.
- B. Where I-5 soil aggregate is specified, the Contractor may substitute DGA with the approval of the Owner or as shown on the construction plans.

**2.2 ACCESSORIES**

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify compacted substrate is dry and ready to support paving and imposed loads.
  - 1. Proof roll substrate in minimum two perpendicular passes to identify soft spots.
  - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.
- B. Verify substrate has been inspected, gradients and elevations are correct.

**3.2 PREPARATION**

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

**3.3 AGGREGATE PLACEMENT**

- A. Install geotextile fabric over subgrade in accordance with manufacturer's instructions.
  - 1. Lap ends and edges minimum 6 inches.
  - 2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.
- B. Place aggregate equal thickness layers to total compacted thickness indicated on Drawings.
  - 1. Maximum Layer Compacted Thickness: 8 inches.
  - 2. Minimum Layer Compacted Thickness: 4 inches.
- C. Roller compact aggregate to 95 percent maximum density
- D. Level and contour surfaces to elevations, profiles, and gradients indicated.
- E. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- F. Maintain optimum moisture content of fill materials to attain specified compaction density.

- G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Maximum Variation from Flat Surface: ½ inch measured with 10 foot straight edge.
- B. Maximum Variation From Thickness: ¼ inch.
- C. Maximum Variation from Elevation: ½ inch.

3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ASTM D1556.ASTM D1557. ASTM D2167, ASTM D2922. ASTM D3017.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- C. Frequency of Tests: One test for every 1000 square yards of each layer compacted aggregate.

3.6 COMPACTION

- A. Compact materials to 98 percent of maximum density as determined from test strip, in accordance with ASTM D2940.

END OF SECTION 321123

**SECTION 32 12 16 - ASPHALT PAVING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Asphalt materials.
  - 2. Aggregate materials.
  - 3. Aggregate subbase.
  - 4. Asphalt paving base course, binder course, and wearing course.
  - 5. Asphalt paving overlay for existing paving.
  - 6. Surface slurry.

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
  - 2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
  - 3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
  - 4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
  - 5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
  - 6. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.
  - 7. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
  - 8. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.
- B. 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.
  - 3. AI SP-2 - Superpave Mix Design.
- C. ASTM International:
  - 1. ASTM C1371[-2004a] - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
  - 2. ASTM C1549[-2004] - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
  - 3. ASTM D242 - Standard Specification for Mineral Filler For Bituminous Paving Mixtures.
  - 4. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
  - 5. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
  - 6. ASTM D977 - Standard Specification for Emulsified Asphalt.
  - 7. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
  - 8. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
  - 9. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
  - 10. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
  - 11. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
  - 12. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

13. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
14. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
15. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
16. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
17. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
18. ASTM E408[-1971(1996)e1] - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
19. ASTM E903[-1996] - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
20. ASTM E1918[-1997] - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
21. ASTM E1980[-2001] - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

### 1.3 SUBMITTALS

- A. Product Data:
  1. Submit product information for asphalt and aggregate materials.
  2. Submit mix design with laboratory test results supporting design.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

### 1.4 QUALITY ASSURANCE

- A. Mixing Plant: In accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 1009.01, as currently amended.
- B. Obtain materials from same source throughout.
- C. Perform Work in accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 401, as currently amended.
- D. Maintain one copy of each document on site.

### 1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 3 years documented experience

### 1.6 AMBIENT CONDITIONS

- A. Do not place asphalt mixture between November 1 and March 1
- B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- C. Place asphalt mixture when temperature is not more than 15 degrees F less than initial mixing temperature.

- D. Do not place asphalt if it is precipitating. Do not allow trucks to leave the plan when precipitation is imminent. The contractor may resume operations when the precipitation has stopped and the surface is free of water.

## PART 2 PRODUCT

### 2.1 ASPHALT PAVING

- A. Asphalt Materials:
  - 1. Asphalt: In accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 901, as currently amended or as shown on the construction plans.
  - 2. Primer: [ASTM D2027, [MC-30] [MC-70] [MC-250]; medium curing, cutback asphalt. In accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
  - 3. Tack Coat: In accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
  - 4. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt paving.
  - 5. Oil: In accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Aggregate Materials:
  - 1. Coarse Aggregate: Specified in Section 32 11 23.
  - 2. Fine Aggregate: In accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended or as shown on the construction plans.
  - 3. Mineral Filler: [ASTM D242] [or] [AASHTO M17]; finely ground mineral particles, free of foreign matter.
- C. Aggregate Subbase: Specified in Section 32 11 23

### 2.2 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: Designed in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- C. Surface Slurry: ASTM D3910, emulsified asphalt slurry.

### 2.3 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: [ASTM D6690] [AASHTO M324], hot applied type.

### 2.4 SOURCE QUALITY CONTROL

- A. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- B. Test samples in accordance with AI MS-2



**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- B. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads.
  - 1. Proof roll subbase with minimum two perpendicular passes to identify soft spots.
  - 2. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23.
- C. Verify gradients and elevations of base are correct.
- D. Verify manhole frames are installed in correct position and elevation.

**3.2 PREPARATION**

- A. Prepare paving plane in accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 401.03.03, as currently amended.

**3.3 DEMOLITION**

- A. Saw cut and notch existing paving as indicted on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.
- D. Asphalt to be removed in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.

**3.4 INSTALLATION**

- A. Subbase:
  - 1. Aggregate Subbase: Install as specified in Section 32 11 23.
- B. Primer:
  - 1. Apply primer in accordance with AI MS-2.
- C. Tack Coat:
  - 1. Apply tack coat in accordance with AI MS-19
    - a. New Surfaces: 1/2 gal/sq yd.
    - b. Existing Surfaces: 1/2 gal/sq yd.
  - 2. Apply tack coat to contact surfaces of curbs, and gutters.
  - 3. Coat surfaces of manhole frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
- D. Single Course Asphalt Paving:
  - 1. Install Work in accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 401, as currently amended or as shown on the construction plans.
  - 2. Place asphalt within 24 hours of applying primer or tack coat.

3. Place asphalt wearing course to thickness indicated on Drawings.
4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

E. Double Course Asphalt Paving:

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to thickness indicated on Drawings.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Asphalt Paving Overlay

1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
2. Install geotextile fabric in accordance with manufacturer's instructions to permit asphalt saturation of fabric. Lap fabric edge and end joints 4 inches.
3. Place wearing course to thickness indicated on Drawings.
4. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

G. Surface Slurry

1. Install uniform thickness surface slurry over existing paving in accordance with ASTM D3910.
2. Allow slurry to cure.
3. Roll paving to achieve uniform surface.

### 3.5 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from Indicated Elevation: Within 1/2 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Take samples and perform tests including mat density tests in accordance with State and local Public Work's Standards.
- B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.
- C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.

- D. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

**3.7 PROTECTION**

- A. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

**3.8 ATTACHMENTS**

- A. Paving at Truck Ramp and Garbage Area: Single course of 3-1/2 inch compacted thickness, with surface slurry.
- B. Paving at Parking Areas: Two courses; binder course of 2-1/2 inch compacted thickness and wearing course of 1 inch compacted thickness.
- C. Paving at Rear Bus Loading Area: Thickness and compaction of subbase to support vehicles up to 30,000 lb.
- D. Paving Front Sidewalks: Thickness and compaction of subbase to support moderate pedestrian traffic.

END OF SECTION 321216

## SECTION 33 05 13 - MANHOLES AND STRUCTURES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Cast in Place concrete manholes and structures with masonry transition to cover frame, covers, anchorage, and accessories.
  - 2. Modular precast concrete manhole and structures with tongue-and-groove joints with masonry transition to cover frame, covers, anchorage, and accessories.

#### 1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 318 - Building Code Requirements for Structural Concrete.
  - 2. ACI 5301 – Standard Specifications for Concrete Construction.
- B. ASTM International:
  - 1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
  - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM C55 - Standard Specification for Concrete Brick.
  - 4. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
  - 5. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.

#### 1.3 DESIGN REQUIREMENTS

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.
- C. Design of Joints for Precast Components: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Indicate manhole and structure locations, elevations, piping, conduit, and sizes and elevations of penetrations.
- B. Product Data: Submit cover and frame construction, features, configuration and, dimensions.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NJDOT Standard Specifications for Road and Bridge Construction, Section 602, as currently amended.

- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Precast Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and structures.
- B. Store precast concrete manholes and structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 50 degrees prior to, during, and 48 hours after completion of masonry work.
- B. Cold Weather Requirements: ACI 530.

PART 2 PRODUCTS

- A. Materials and Resources Characteristics:
  - 1. Recycled Content Materials: Furnish materials with maximum available recycled content.
  - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site.

2.2 MANHOLES AND STRUCTURES

- A. Manufacturers:
  - 1. Flemington Precast & Supply, L.L.C.
  - 2. J.F. Gillespie, Inc.
  - 3. Northeast Concrete Products
  - 4. Oldcastle Precast, Inc.
  - 5. Campbell Foundry
  - 6. Or Approved Equal
- B. Manhole and Structure Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923
- C. Reinforcement: Formed steel wire, galvanized finish, unfinished.

2.3 FRAMES AND COVERS

- A. Manufacturers:

1. Barry Pattern & Foundry Co., Inc
2. East Jordan Iron Works, Inc.
3. McKinley Iron Works, Inc.
4. Neenah Foundry
5. Campbell Foundry
6. Or Approved Equal

- B. Product Description: ASTM A48/A48M, Class 30B Cast iron construction, machined flat bearing surface, removable lockable, boltable, lid, closed, open, checkerboard grille, cover design; sealing gasket;

#### 2.4 COMPONENTS

- A. Manhole and Structure Steps: Formed galvanized steel, aluminum, FRP, rungs; 3/4 inch diameter. Formed integral with manhole and structure sections.
- B. Strap Anchors: Bent steel shape, galvanized.

#### 2.5 CONFIGURATION

- A. Shaft Construction: Concentric with concentric, eccentric cone top section; lipped male/female dry joints; sleeved to receive pipe
- B. Shape: Cylindrical or as indicated on Drawings.
- C. Clear Inside Dimensions: As indicated on Drawings.
- D. Design Depth: As indicated on Drawings.
- E. Clear Cover Opening: As indicated on Drawings.
- F. Pipe Entry: Furnish openings as indicated on Drawings
- G. Steps: As indicated on Drawings.

#### 2.6 FINISHING - STEEL

- A. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify built-in items are in proper location, and ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

**3.2 PREPARATION**

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.
- D. Clean existing impacted structures by removing any debris or sediment prior to modification.

**3.3 INSTALLATION**

- A. Excavation and Backfill:
  - 1. Excavate for manholes and structures in location and to depth shown on Drawings. Provide clearance around sidewalls of structure for construction operations.
- B. Place base pad, trowel top surface level.
- C. Place manhole and structure sections plumb and level, trim to correct elevations, anchor to base pad.
- D. Install manholes and structures supported at proper grade and alignment on coarse aggregate bedding, No. 57 or as shown on Drawings.
- E. Backfill excavations for manholes and structures with fill.
- F. Form and place manhole and structures cylinder plumb and level, to correct dimensions and elevations. As Work progresses, build fabricated metal items.
- G. Cut and fit for pipes and sleeves.
- H. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel
- I. Set cover frames and covers level without tipping, to correct elevations.
- J. Coordinate with other sections of Work to provide correct size, shape, and location.

**3.4 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION**

- A. Lift precast components at lifting points designated by manufacturer.
- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- C. Set precast structures bearing firmly and fully on crushed stone bedding or as Shown on Drawings.
- D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at manufacturer's plant.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.
- I. Cut pipe to finish flush with interior of structure.
- J. Shape inverts through manhole and structures as shown on Drawings.

### 3.5 CAST-IN-PLACE CONCRETE MANHOLE AND STRUCTURE INSTALLATION

- A. Prepare crushed stone bedding or other support system shown on Drawings, to receive base slab as specified for precast structures.
- B. Place and cure concrete.

### 3.6 FRAME AND COVER INSTALLATION

- A. Set frames using mortar and masonry. Install radially laid concrete brick with 1/4 inch thick vertical joints at inside perimeter. Lay concrete brick in full bed of mortar and completely fill joints. Where more than one course of concrete brick is required, stagger vertical joints.
- B. Set frame and cover 2 inches above finished grade for manholes and structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

### 3.7 FIELD QUALITY CONTROL

- A. Test concrete manhole and structure sections in accordance with ASTM C497
- B. Test cast-in-place concrete.
- C. Vertical Adjustment of Existing Manholes and Structures:
  - 1. Where required, adjust top elevation of existing manholes and structures to finished grades shown on Drawings.
  - 2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
  - 3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.
  - 4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete.

END OF SECTION 330516



**SECTION 33 12 13 - WATER SERVICE CONNECTIONS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings for domestic water service connections.
  - 2. Meter setting equipment.
  - 3. Water meters.
  - 4. Backflow preventers.
  - 5. Underground pipe markers.
  - 6. Precast concrete vault.
  - 7. Bedding and cover materials.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Pipe and Fittings:
  - 1. Basis of Payment: Includes hand trimming excavation, pipe and fittings, bedding, concrete thrust restraints, connection to future building service piping, and to municipal utility water source.
- B. Corporation Stop Assembly:
  - 1. Basis of Payment: Includes corporation stop, fittings and accessories.
- C. Curb Stop Assembly:
  - 1. Basis of Payment: Includes curb stop, curb box and cover, fittings, and accessories.
- D. Water Meters:
  - 1. Basis of Payment: Includes meter, meter setting equipment, fittings and accessories.
- E. Backflow Preventers:
  - 1. Basis of Payment: Includes backflow preventer, fittings and accessories.

1.3 REFERENCE STANDARDS

- 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. American Society of Mechanical Engineers:
  - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. American Society of Sanitary Engineering:
  - 1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
  - 2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
- D. ASTM International:
  - 1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
  - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
  - 3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

4. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
5. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
7. ASTM D1785 - Standard Specification for (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
8. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
9. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
2. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
3. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
4. AWWA C702 - Cold-Water Meters - Compound Type.
5. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
6. AWWA C800 - Underground Service Line Valves and Fittings.
7. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.
8. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
9. NJ American Water
  - a. Contact Information: 908-431-3240

#### 1.4 SUBMITTALS

- A. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.
- B. Shop Drawings: Provide shop drawings for precast concrete vaults to include detail drawings showing the vault and accessories.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements

#### 1.5 SUSTAINABLE DESIGN SUBMITTALS – NOT USED

#### 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.

- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NJ American Water
- B. Maintain one copy of each document on site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.
- B. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.
- C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS – NOT USED

2.2 WATER PIPING AND FITTINGS

- A. Ductile Iron Pipe:
- B. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- C. Corporation Stops:
  - 1. Brass or red brass alloy body conforming to ASTM B62.
  - 2. Inlet end threaded for tapping according to AWWA C800.
  - 3. Outlet end suitable for service pipe specified.
- D. Service Saddles:
  - 1. Double strap type, designed to hold pressures in excess pipe working pressure.

2.3 CURB STOP ASSEMBLY

- A. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Curb Stops:
  - 1. Brass or red brass alloy body conforming to ASTM B62.
  - 2. Plug type valve.
  - 3. Positive pressure sealing.
- C. Curb Boxes and Covers:
  - 1. Cast iron body, Extension Type or Buffalo Type.
  - 2. Minneapolis or Arch Pattern Base.
  - 3. Lid with inscription WATER, with Pentagon Plug.

**2.4 METER SETTING EQUIPMENT**

- A. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Outside Meter Setting:
  - 1. Meter Yokes: Copper or iron, riser type assembly with bronze inlet inverted key angle valve expansion type outlet connection and Ell fitting; flared copper tubing connections both ends.
  - 2. Meter Yokes: Copper or iron, inlet and outlet horizontal or vertical setting with matching couplings, fittings and stops.

**2.5 WATER METERS**

- A. Furnish materials in accordance with NJ American water standards.

**2.6 BACKFLOW PREVENTERS**

- A. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Reduced Pressure Backflow Preventers:
  - 1. Comply with ASSE 1013.
  - 2. Bronze body, with bronze internal parts and stainless steel springs.
  - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- C. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

**2.7 UNDERGROUND PIPE MARKERS**

- A. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- C. Trace Wire: Electronic detection materials for non-conductive piping products.
  - 1. Unshielded 10 gage THWN insulated copper wire.
  - 2. Conductive tape.

**2.8 PRECAST CONCRETE VAULT**

- A. Furnish materials in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Product Description: Precast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.
- C. Shape: indicated on Drawings.

- D. Riser Casting: 6 inch, with manhole step cast into frame.
- E. Frames and Covers: ASTM A48/A48M; Class 30B gray cast iron, 30 inch size, machine finished with flat bearing surfaces. Furnish cover marked WATER SERVICE to indicate utility.
- F. Pipe Entry Locations: As indicated on Drawings.
- G. Steps: Polypropylene plastic step with 1/2-inch steel reinforcement or Cast steps at 12 inches on center vertically.

**2.9 BEDDING AND COVER MATERIALS**

- A. Bedding: Fill Type A1 as specified in Section 31 23 23.
- B. Cover: Fill Type A1, as specified in Section 31 23 23.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1, as specified in Section 31 23 23. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

**2.10 ACCESSORIES**

- A. Manhole and Cover: Refer to Section 33 05 13.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify future building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

**3.2 PREPARATION**

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

**3.3 INSTALLATION - CORPORATION STOP ASSEMBLY**

- A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the Engineer.
- B. Provide service clamps for mains other than of cast iron or ductile iron mains.
- C. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock position on main's circumference; locate corporation stops at least 12 inches apart longitudinally and staggered.

- D. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2 inches width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.
- E. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by the Engineer.

#### 3.4 BEDDING

- A. Backfill around sides and to top of pipe in accordance with Section 31 23 23.
- B. Place fill material in accordance with Section 31 23 23.

#### 3.5 INSTALLATION - PIPE AND FITTINGS

- A. Maintain separation of water main from sewer piping in accordance with NJ American Water Regulations.
- B. Group piping with other site piping work whenever practical.
- C. Route pipe in straight line.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Install access fittings to permit disinfection of water system.
- F. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- G. Establish elevations of buried piping with not less than 3 ft of cover.
- H. Backfill trench in accordance with Section 31 23 23.

#### 3.6 INSTALLATION - CURB STOP ASSEMBLY

- A. Set curb stops on compacted soil.
- B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

#### 3.7 INSTALLATION - WATER METERS

- A. Install Work in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.

#### 3.8 INSTALLATION - BACKFLOW PREVENTERS

- A. Install backflow preventer where indicated on the Contract Drawings and in accordance with manufacturer's instructions.
- B. Comply with local water company requirements and plumbing codes in regards to testing and installation requirements.

**3.9 SERVICE CONNECTIONS**

- A. Install water service in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Install Work in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.

**3.10 PRECAST CONCRETE VAULT**

- A. Construct valve vaults of precast concrete.
- B. Seal vault joints watertight with preformed plastic joint sealant compound. Apply asphalt waterproofing to exterior walls.
- C. Seal annular space between pipe and wall sleeves as indicated on the Contract Drawings.
- D. Install vault covers and frames; adjust to finished grade elevation.

**3.11 FIELD QUALITY CONTROL**

- A. Perform pressure test on domestic site water distribution system in accordance with NJDOT Standard Specifications for Road and Bridge Construction, as currently amended.
- B. Compaction Testing for Bedding: In accordance with ASTM D698.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Compaction Tests: Every 100 feet.

END OF SECTION

**SECTION 331416 - SITE WATER UTILITY DISTRIBUTION PIPING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for Site water line, including domestic water service line and fire service water line.
2. Tapping sleeves and valves.
3. Valves and boxes.  
Bedding and cover materials.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
3. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.
2. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.

D. ASTM International:

1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
4. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
5. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
6. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
7. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.



8. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
9. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
10. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

E. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
5. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger.
6. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
7. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
8. AWWA C206 - Field Welding of Steel Water Pipe.
9. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
10. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
11. AWWA C213 - Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
12. AWWA C300 - Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
13. AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
14. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
15. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
16. AWWA C606 - Grooved and Shouldered Joints.
17. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
18. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In.(13 mm) Through 3 In. (76 mm) for Water Service.
19. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Waterworks.

F. American Welding Society:

1. AWS A5.8- Specification for Filler Metals for Brazing and Braze Welding.

G. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

H. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, valves, and hydrants.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and installer.

### 1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Manufacturer's Certificate:
  - 1. Materials Resources Certificates:
    - a. Certify source and origin for salvaged and restored products.
    - b. Certify recycled material content for recycled content products.
    - c. Certify source for regional materials and distance from Project Site.
- B. Product Cost Data:
  - 1. Submit cost of products to verify compliance with Project sustainable design requirements.
  - 2. Exclude cost of labor and equipment to install products.
  - 3. Provide cost data for following products:
    - a. Salvaged, refurbished, and reused products.
    - b. Products with recycled material content.
    - c. Regional products.

### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

### 1.6 QUALITY ASSURANCE

- A. Valves: Mark valve body with manufacturer's name and pressure rating.
- B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- C. Perform Work according to state and local standards.
- D. Maintain 1 copy of each standard affecting Work of this Section on Site.

### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience in installation of Work of this Section.

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### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Block individual and stockpiled pipe lengths to prevent moving.
  - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
  - 4. Store PE and PVC materials out of sunlight.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 PIPING

- A. Ductile Iron Pipe:
  - 1. Comply with AWWA
  - 2. Joints:
    - a. Comply with AWWA C111.
    - b. Provide rubber gasket with rods.
  - 3. Jackets: AWWA C105 PE jacket
- B. Copper Tubing:
  - 1. Comply with ASTM B88
- C. PVC Pipe:
  - 1. [ASTM D1785, Schedule 40] [ASTM D1785, Schedule 80]
  - 2. Fittings: PVC, ASTM D2466.
  - 3. Joints:
    - a. Comply with ASTM D2855.
    - b. Type: Solvent weld.

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### D. PVC Pipe:

1. Comply with AWWA C900, Class [165] [235].
2. Fittings:
  - a. Material: Cast iron.
  - b. Comply with AWWA C111.
3. Joints:
  - a. Comply with ASTM D3139.
  - b. Furnish compression gasket ring.

### E. Steel Pipe:

1. Comply with AWWA C200.
2. Fittings and Special Sections: Comply with AWWA C208.
3. Flanges:
  - a. Comply with AWWA C207[, Class D].
  - b. Type: Slip-on.
4. Field Welding Materials: Comply with AWWA C206.
5. Interior Cement Mortar Lining: Comply with AWWA C205.
6. Buried Steel Pipe Exterior Lining:
  - a. Description: Shop-applied prime coat and coal tar enamel protective coating.
  - b. Comply with AWWA C203.

### F. Concrete Pipe:

1. Comply with AWWA C301.
2. Type: Prestressed concrete cylinder pipe.
3. Fittings:
  - a. Comply with AWWA C300.
  - b. Furnish [adaptors] [valves] for concrete-to-iron pipe connections.
4. Joints:
  - a. Comply with AWWA C300.
  - b. Type: Rubber gasket.
5. Exterior Mortar Coating: Comply with AWWA C301.

### G. PE Pipe:

1. Pipe: Comply with [AWWA C901] [AWWA C906]
2. Fittings:
  - a. Comply with AWWA C901.

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### 2.2 TAPPING SLEEVES AND VALVES

#### A. Tapping Sleeves:

1. Manufacturers:
  - a. Furnish materials according to construction documents.

#### B. Description:

1. Material: Ductile or cast iron.
2. Type: Dual compression.
3. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class [125], and MSS SP-60.

#### C. Tapping Valves:

1. Manufacturers:
  - a. Furnish materials according to construction documents.

#### D. Description:

1. Comply with AWWA C500.
2. Type: Double disc with non-rising stem.
3. Inlet Flanges: Comply with ASME B16.1, Class 125, and MSS SP-60.
4. Mechanical Joint Outlets: Comply with AWWA C111.
5. Mark manufacturer's name and pressure rating on valve body.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that building service connections and municipal utility water main sizes, locations, and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.
- D. Protect and support existing distribution piping and appurtenances as Work progresses.

### 3.3 INSTALLATION

#### A. Bedding:

1. Excavate pipe trench as specified in Section 312317 - Trenching

2. Edit following Subparagraph to suit pipe diameter, types of pipe bends, and soil-bearing conditions.
3. Placement:
  - a. Place bedding material as indicated on Drawings.
  - b. Level fill materials in one continuous layer not exceeding 8 inches of compacted depth.
  - c. Compact to 95 percent maximum density.
4. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact to 95 percent maximum density.
5. Place fill materials as specified in Section 312323 - Fill.

**B. Pipe and Fittings:**

1. Maintain separation of water main according to state and local code.
2. Group piping with other Site piping work whenever practical.
3. Install pipe to elevations indicated on Drawings.
4. Install ductile-iron piping and fittings according to AWWA C600.
5. Install grooved and shouldered pipe joints according to AWWA C606.
6. Route pipe in straight line.
7. Install access fittings to permit disinfection of water system.
8. Thrust Restraints:
  - a. Form and place concrete for pipe thrust restraints at each elbow or change of pipe direction.
  - b. Place concrete to permit full access to pipe and pipe accessories.
  - c. Provide bearing area as indicated on Drawings.
9. Installation Standards: Install Work according to state and local standards.

**3.4 FIELD QUALITY CONTROL**

**A. Testing:**

1. Perform pressure test on piping according to state and local standards.
2. Compaction Testing:
  - a. Comply with ASTM D1557.
  - b. Frequency of Compaction Tests: As specified by the Engineer on Record.
  - c. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION 331416

**SECTION 337900 - SITE GROUNDING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Rod electrodes.
  - 2. Active electrodes.
  - 3. Exothermic connections.
  - 4. Mechanical connectors.
  - 5. Wire.
  - 6. Grounding well components.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE 80 - Guide for Safety in AC Substation Grounding.
  - 2. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 3. IEEE C2 - National Electrical Safety Code.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SYSTEM DESCRIPTION

- A. Multiple vertical, plate or rod electrodes buried in configuration as indicated on Drawings.
- B. Single vertical rod electrode for local grounding at utility transformer or pole foundation.

1.4 PERFORMANCE REQUIREMENTS

- A. Overall Resistance to Ground: 25 ohms.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate layout and installation details of grounding components.
- B. Product Data: Submit data for grounding electrodes and connectors.
- C. Test Reports: Indicate overall resistance to ground.

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### 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of electrodes and connections.

### 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with National Electrical Code.
- B. Maintain one copy of each document on site.
- C. Conform to IEEE 142.
- D. Substation Grounding: Conform to IEEE 80.

### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

## PART 2 - PRODUCTS

### 2.1 ROD ELECTRODES

- A. Product Description: Copper or Copper-clad steel ground rods.
- B. Diameter: 3/4-inch minimum or as shown on Drawings.
- C. Length: 10 feet or as shown on Drawings.

### 2.2 ACTIVE ELECTRODES

- A. Product Description: Metallic-salt-filled copper tube electrode.
- B. Shape: As indicated on Drawings.
- C. Connector: Suitable for exothermic welded connection.

### 2.3 EXOTHERMIC CONNECTIONS

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

### 2.4 MECHANICAL CONNECTORS

- A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.



2.5 WIRE

- A. Material: Stranded copper.
- B. Horizontal Electrodes: 4/0 AWG, minimum size.
- C. Connections to Electrodes: 2/0 AWG, minimum size.
- D. Bonding Other Objects: 2 AWG, minimum size.
- E. Mechanical Connector: Bronze.
- F. Grounding Boxes: Bronze.

2.6 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8-inch diameter by 24-inch long clay tile pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.
- C. Treatment Well Liner: 8-inch diameter clay tile perforated pipe.

2.7 ACCESSORIES

- A. Treatment Chemicals: Use magnesium sulfate (Epsom salts), or copper sulfate (blue vitriol) suitable ion-producing, non-corrosive and non-toxic treating chemicals.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.
- B. Verify trenching is completed before installing horizontal electrodes.

3.2 EXISTING WORK

- A. Remove exposed abandoned grounding components. Cut conductors flush with grade and paving, and patch surfaces.
- B. Provide access to existing grounding electrodes, connections, and other installations remaining active and requiring access. Modify installation or install wells as indicated on Drawings.
- C. Extend existing site grounding installations using materials and methods compatible with existing installations, or as specified.
- D. Clean and repair existing grounding connections remaining.

**3.3 INSTALLATION**

- A. Install rod electrodes in vertical position with bottom at least 5 feet below frost line.
- B. Install interconnecting wire 2 feet below finished grade level.
- C. Install grounding wells and grounding boxes as indicated on Drawings at each electrode.
- D. Provide chemical treatment where indicated on Drawings.
  - 1. Saturate treatment chemicals with water following application.
  - 2. Dig circular trench centered on electrode. Make trench 12 inches deep with 18 inch inside diameter. Uniformly distribute 50-lb of treatment material in bottom of trench and cover with topsoil.
- E. Treatment Wells:
  - 1. Lining: Install to depth of 60 inches.
  - 2. Well Pipe and Cover: Install flush with finished grade.

**3.4 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13. Make final grounding system measurements three or four days after chemical treatment.

**3.5 DEMONSTRATION**

- A. Demonstrate location of each accessible grounding connection and each chemical treatment well.

END OF SECTION 337900