PROJECT MANUAL

INCLUDING CONSTRUCTION SPECIFICATIONS

for

V-S035, - TERMINAL C ASC LEVEL 2 EMERGENCY EGRESS (D/B)

ORLANDO INTERNATIONAL AIRPORT

Orlando, Florida 32827

CONTRACT DOCUMENTS

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VOLUME 6 OF 10



GREATER ORLANDO AVIATION AUTHORITY

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SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.
- B. Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation are included by reference for information only.
- C. Division 01 Section 01 81 13 Sustainable Design Requirements LEED v4 BD+C for additional LEED v4 requirements related to commissioning.
- D. ASHRAE standard 90.1-2010, ASHRAE Guideline 0-2013 (The Commissioning Process) and ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.
- E. NFPA 3 Recommended Practice for Commissioning of Fire Protection and Life Safety Systems. NFPA 4 - Standard for Integrated Fire Protection and Life Safety System Testing

1.2 SUMMARY

- A. A. This section includes commissioning process requirements for Fire Suppression systems, assemblies and equipment.
- B. B. Related Sections:
 - 1. 1. Section 01 91 13 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DESCRIPTION

- A. Refer to Section 01 91 13 "General Commissioning Requirements" for the description of commissioning.
- 1.4 DEFINITIONS
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for definitions.
- 1.5 SUBMITTALS
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for CxA's role.
 - B. Refer to Section "Submittals" for specific requirements. In addition, provide the following:
 - 1. Certificates of readiness

- 2. Certificates of completion of installation, pre-start, and start-up activities.
- 3. Test reports
- 4. O&M manuals

1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the contractor for the equipment being tested. For example, the fire protection contractor shall ultimately be responsible for all standard testing equipment for the fire protection systems under their control. A sufficient quantity of two-way radios shall be provided by each subcontractor.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall

have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the CxA will prepare Verification Checklists for all commissioned components, equipment, and systems.
- B. Red-lined Drawings:
 - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
 - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
 - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
 - 4. The contracted party, as defined in the Contract Documents will create the asbuilt drawings.
- C. Operation and Maintenance Data:
 - 1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
 - 2. The CxA will review the O&M literature once for conformance to project requirements.
 - 3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the contractor.
- D. Demonstration and Training:
 - 1. Contractor will provide demonstration and training as required by the specifications.
 - 2. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training.
 - 3. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session.
 - 4. The CxA shall be notified at least 72 hours in advance of scheduled pump test so that testing may be observed by the CA and representatives of the Owner. A copy of the test record shall be provided to the CxA, the Owner's Representative and the Engineer-of-Record.
 - 5. Engage a Factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
 - 6. Engage a Factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain Fire Pump.
 - 7. Train the Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining units.
 - 8. Review data in O&M Manuals.

- E. Systems Manual requirements:
 - 1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
 - 2. The CMAR and subcontractors shall include final approved versions of the following information for the Systems Manual:
 - a. As-Built System Schematics
 - b. Verified Record Drawings
 - c. Test Results (not otherwise included in Cx Record)
 - d. Periodic Maintenance Information for computer maintenance management system
 - e. Recommendations for recalibration frequency of sensors and actuators
 - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
 - g. Training Records, Information on training provided, attendees list, and any on-going training
 - h. Copy of all related NFPA 20 and NFPA 70 documentation.
 - 3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, air distribution, etc.
 - 4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CMAR and SUBCONTRACTOR'S RESPONSIBILITIES

- A. Fire Protection Contractor. The commissioning responsibilities applicable to the Fire Protection Contractor are as follows (all references apply to commissioned equipment only):
 - 1. Perform commissioning tests at the direction of the CxA.
 - 2. Attend construction phase coordination meetings.
 - 3. Participate in Fire Suppression systems, assemblies, equipment, and component maintenance orientation and inspection, as directed by the CxA.
 - 4. Provide information requested by the CxA for final commissioning documentation.
 - 5. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
 - 6. Prepare preliminary schedule for Fire Suppression systems orientations and inspections, operation and maintenance manual submissions, training sessions, flushing and cleaning, equipment start-up, and task completion by Owner. Distribute preliminary schedule to commissioning team members.
 - 7. Update schedule, as required, throughout the construction period.
 - 8. During the installation, start-up and initial checkout process, complete the Fire Protection-related portions of the verification (pre-functional) checklists for all commissioned equipment. Note: checklists will be maintained on a cloud-based Cx web application, refer to Section 01 91 13.
 - 9. Assist the CxA in all verification and functional performance tests.

- 10. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- 11. Gather operation and maintenance literature on all equipment, and assemble in binders, as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- 12. Coordinate with the CxA to provide forty-eight (48) hour advance notice, so the witnessing of equipment and system start-up and testing can begin.
- 13. Participate in, and schedule vendors and contractors to participate in, the training sessions.
- 14. Provide written notification to the CMAR and the CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems and sub-systems are operating as required:
 - a. Fire suppression equipment, including: pumps, piping, control valves, and all other equipment under their control.
 - b. Automatic sprinkler system
 - c. Fire stopping in fire-rated construction, including caulking, gasketing and sealing of smoke barriers.
- B. The equipment supplier shall document the performance of his equipment.
- C. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- D. Equipment Suppliers
 - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - 2. Assist in equipment testing per agreements with contractors.
 - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- E. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- F. Refer to Section 01 91 13 "General Commissioning Requirements" for additional contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

- A. Refer to Section 01 91 13 "General Commissioning Requirements" for Owner's Responsibilities.
- 3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for Design Professional's Responsibilities.
- 3.5 COMMISSIONING AUTHORITY'S (CxA's) RESPONSIBILITIES

A. Refer to Section 01 91 13 "General Commissioning Requirements" for CxA's Responsibilities.

3.6 TESTING PREPARATION

- A. Certify in writing to the CxA that Fire Suppression systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Fire Suppression instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Fire Protection testing shall include entire Fire Suppression installation. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
- D. The Fire Suppression contractor shall prepare detailed testing plans, procedures, and checklists for Fire Suppression systems, subsystems, and equipment and submit to the CxA for review.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Fire Suppression system, document the deficiency and report it to Owner's Representative. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- 3.8 5.8 FIRE SUPPRESSION SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES
 - A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual technical sections. Provide submittals, test data, inspector record, and certifications to the CxA.
 - B. Fire Suppression Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of sprinkler distribution systems.
 - C. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
 - 1. Fire Suppression Standpipes
 - 2. Wet-Pipe Sprinkler System
 - 3. Centrifugal Fire Pump
 - 4. Pressure maintenance pump
- 3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.
- 3.10 APPROVAL
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for approval procedures.
- 3.11 DEFERRED TESTING
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to deferred testing.
- 3.12 OPERATION AND MAINTENANCE MANUALS

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- A. Refer to Section 01 91 13 "General Commissioning Requirements" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.
- 3.13 TRAINING OF OWNER PERSONNEL
 - A. Refer to Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to training.

END OF SECTION 21 08 00

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Hose connections.
 - 4. Fire-department connections.
 - 5. Alarm devices.
 - 6. Pressure gages.

B. Related Sections:

- 1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
- 2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
- 3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps"

1.2 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure or 250 psig working pressure where required.
- B. Layout: Layout fire-suppression standpipes using requirements and design criteria indicated. Layout and pipe sizes not to be less than those shown on plan documents.
- C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - Minimum residual pressure at each hose-connection outlet is as follows:
 a. NPS 2-1/2 (DN 65) Hose Connections: 100 psig
 - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
 - a. NPS 2-1/2 (DN 65) Hose Connections: 175 psig

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Each product shall be FM approved and shall be indicated on the product data submitted.

- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- 1.5 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For qualified Installer.
 - B. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable. Provide coordination drawings as a separate submittal. Coordination shall be the responsibility of the installing contractor and coordination drawings shall include the verification of coordination by the fire sprinkler contractor, plumbing, HVAC and electrical contractor at a minimum.
 - C. Welding certificates.
 - D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
 - E. Field quality-control reports.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, coordinating, and installing firesuppression standpipes. Base calculations on results of fire-hydrant flow test or existing fire pump test report as applicable.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

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2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Standard-Weight, Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME B16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. <u>Manufacturers</u>: 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. <u>Anvil International, Inc</u>.
 - b. <u>Corcoran Piping System Co</u>.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. <u>Victaulic Company</u>.
 - 2. Pressure Rating: 250 psig (1725 kPa) minimum as necessary.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. All equipment shall be FM approved.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psig where required
- B. Check 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. <u>AFAC Inc</u>.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. <u>Anvil International, Inc</u>.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. <u>Crane Co.; Crane Valve Group; Crane Valves</u>.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. <u>Globe Fire Sprinkler Corporation</u>.
 - I. <u>Groeniger & Company</u>.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. <u>Milwaukee Valve Company</u>.
 - q. <u>Mueller Co.; Water Products Division</u>.
 - r. <u>NIBCO INC</u>.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. <u>Shurjoint Piping Products</u>.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
 - 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.
- C. Indicating-Type 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. <u>Anvil International, Inc</u>.
 - b. Fivalco Inc.
 - c. <u>Global Safety Products, Inc</u>.
 - d. Kennedy Valve; a division of McWane, Inc.

- e. <u>Milwaukee Valve Company</u>.
- f. <u>NIBCO INC</u>.
- g. <u>Shurjoint Piping Products</u>.
- h. <u>Tyco Fire & Building Products LP</u>.
- i. <u>Victaulic Company</u>.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig (1200 kPa) minimum or 250 psig where required
- 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
- 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
- 6. Valve Operation: Integral [electrical, 115-V ac, prewired, single-circuit, supervisory switch

2.5 HOSE CONNECTIONS

- A. Adjustable-Valve Hose Connections:
 - 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. <u>AFAC Inc</u>.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. <u>GMR International Equipment Corporation</u>.
 - f. Guardian Fire Equipment, Inc.
 - g. <u>Potter Roemer</u>.
 - h. Tyco Fire & Building Products LP.
 - i. <u>Wilson & Cousins Inc</u>.
 - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - 2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
 - 3. Pressure Rating: 300 psig minimum.
 - 4. Material: Brass or bronze.
 - 5. Size: NPS 2-1/2 as indicated.
 - 6. Inlet: Female pipe threads.
 - 7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 - 8. Pattern: Angle or gate.
 - 9. Pressure-Control Device Type: Pressure regulating
 - 10. Design Outlet Pressure Setting: 175
 - 11. Finish: Rough brass or bronze

- B. Nonadjustable-Valve Hose Connections:
 - 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. <u>AFAC Inc</u>.
 - b. <u>Elkhart Brass Mfg. Company, Inc</u>.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. <u>GMR International Equipment Corporation</u>.
 - f. Guardian Fire Equipment, Inc.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. <u>Mueller Co.; Water Products Division</u>.
 - i. <u>NIBCO INC</u>.
 - j. Potter Roemer.
 - k. Tyco Fire & Building Products LP.
 - I. <u>Wilson & Cousins Inc</u>.
 - 2. Standard: UL 668 hose valve for connecting fire hose.
 - 3. Pressure Rating: 300 psig minimum.
 - 4. Material: Brass or bronze.
 - 5. Size: NPS 2-1/2 as indicated.
 - 6. Inlet: Female pipe threads.
 - 7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 - 8. Pattern: Angle or gate.
 - 9. Finish: Rough brass or bronze

2.6 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
 - 1. <u>Manufacturers</u>: 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. <u>ADT Security Services, Inc</u>.
 - b. <u>McDonnell & Miller; ITT Industries</u>.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - 2. Standard: UL 346.
 - 3. Water-Flow Detector: Electrically supervised.
 - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 5. Type: Paddle operated.
 - 6. Pressure Rating: 250 psig
 - 7. Design Installation: Horizontal or vertical.

- C. Valve Supervisory Switches:
 - 1. <u>Manufacturers</u>: 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. <u>Fire-Lite Alarms, Inc.; a Honeywell company</u>.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. <u>Potter Electric Signal Company</u>.
 - d. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.

2.7 PRESSURE GAGES

- A. <u>Manufacturers:</u> 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. <u>AMETEK; U.S. Gauge Division</u>.
 - 2. Ashcroft Inc.
 - 3. <u>Brecco Corporation</u>.
 - 4. <u>WIKA Instrument Corporation</u>.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

- A. Refer to specification 21 13 13
- 3.2 PIPING INSTALLATION
 - A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from engineer of record approved working plans for piping require written approval from the EOR. Deviations to be requested prior to shop drawing submittal.

- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install drain valves on standpipes. Extend drain piping to outside of building or floor drain as applicable.
- E. Install alarm devices in piping systems.
- F. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 and FM data sheets for hanger materials.
- G. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- H. Fill wet-type standpipe system piping with water.
- I. Install sleeves for piping penetrations of walls, ceilings, and floors.
- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping." 21 13 13.
- L. All standpipe insulation in the parking garage to be primed and painted.
- M. All floor penetrations of the parking garage to be sleeved and approved by Walker Parking prior to the installation of sleeves. Sleeves to be steel.
- N. Where standpipe piping passes through areas not enclosed with walls, or exposed to outside temperatures below 40 degrees, the piping shall be primed, painted, provided with UL listed heat trace and provided with a weatherproof insulation. This shall include at a minimum all piping at the ground level of the Airside Building.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanizedsteel pipe.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.5 HOSE-CONNECTION INSTALLATION

- A. Install hose connections on standpipes and fire hose piping at hose stations as indicated.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter.
- D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Extinguisher Cabinets. Fire Hose Valve cabinets to match fire extinguisher cabinets and be submitted to and approved by the Architect prior to procurement"
- E. All buildings with standpipe systems, including the open parking garage to be provided with fire hose cabinets. Cabinets to be stainless steel.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Refer to section 21 13 13.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals in accordance with NFPA 70 and NFPA 72.-Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 PIPING SCHEDULE

- A. Wet-type, fire-suppression standpipe piping, NPS 2 and smaller shall be the following:
 - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- B. Wet-type, fire-suppression standpipe piping, NPS 2 ¹/₂" and larger shall be the following:
 - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 2. Schedule 40 is permitted for threaded piping.

END OF SECTION 211200

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Pressure gages.
- B. Related Sections:
 - 1. Section 21_12_00 "Fire-Suppression Standpipes" for standpipe piping.
 - 2. Section 21_13_16 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
 - 3. Section 21_31_13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressuremaintenance pumps, and fire-pump controllers.

1.3 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to the water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Delegated Layout: Design sprinkler system(s) using performance requirements and design criteria indicated.
 - 1. Available fire-hydrant flow test records indicate the following conditions (at the time of the Parking Garage Permit Submittal, an on-site fire hydrant flow test was not available. Calculations for the Garage to be based upon the fire pump test report of the pump installed in Phase 1 of the Garage):
 - a. Date: 06-19-2017
 - b. Time: 9am

- c. Performed by: OUC
- d. Location of Residual Fire Hydrant R: Hydrant HSE33I01
- e. Location of Flow Fire Hydrant F: Hydrant HSE 33J01
- f. Static Pressure at Residual Fire Hydrant R: 68 psig
- g. Measured Flow at Flow Fire Hydrant F: 984 gpm
- h. Residual Pressure at Residual Fire Hydrant R: 56 psig
- 2. A second fire hydrant flow test was taken on site by Farrell Fire Protection, LLC. The following are the results:
 - a. Date: 12-29-2016
 - b. Time: 9:15 am
 - c. Performed by: Farrell Fire Protection
 - d. Location of Residual Fire Hydrant R: See Contract Documents for locations
 - e. Static Pressure at Residual Fire Hydrant R: 65 psig
 - f. Measured Flow at Flow Fire Hydrant F: 1000 gpm
 - g. Residual Pressure at Residual Fire Hydrant R: 53 psig
- C. Sprinkler system design shall be approved by the engineer of record, FM Global, and authorities having jurisdiction prior to installation.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers. The 10 percent shall be at the fire pump discharge.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 2 / HC-2
 - b. Building Service Areas: Ordinary Hazard, Group 2 / HC-2
 - c. Passenger Handling Areas: Ordinary Hazard 1
 - d. Electrical, IDF, MDF, Telco, LAN, and similar Rooms: Ordinary Hazard, Group 2 / HC-2
 - e. General Storage Areas: Ordinary Hazard, Group 2 / HC-2
 - f. Mechanical Equipment Rooms: Ordinary Hazard, Group 2 / HC-2
 - g. Retail: Ordinary Hazard Group 2, HC-2
 - h. Trash, Commissary, Tenant Storage, Loading Dock, : Ordinary Hazard, Group-2 / HC-2
 - i. Baggage Handling Areas: Ordinary Hazard Group 2 / HC-2
 - j. Baggage Sortation: Ordinary Hazard Group 2 / HC-2
 - k. Office, corridor, bathrooms, Locker, and similar: Light Hazard / HC-1
 - I. Shell Space: Ordinary Hazard Group 2 / HC-2
 - 3. Minimum Density for Automatic-Sprinkler Piping Design using standard spray sprinklers:
 - Light-Hazard Occupancy / HC-1: 0.10 gpm over 1500-sq. ft. area for wet-pipe with ceiling heights less than 30 ft.
 - 1) For ceiling heights 30-60 ft, a 0.20 gpm over 2500 sq.ft. is required. Dry-Pipe to have remote area increased to 3500 sq.ft.
 - 2) For celling heights 60 ft to 100 ft, (12) K25.2 sprinklers at 7 psi
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 2500-sq. ft. area.
 - 1) For ceiling heights 30-60 ft, a 0.20 gpm over 2500 sq.ft. is required. Dry-Pipe to have remote area increased to 3500 sq.ft.
 - 2) For celling heights 60 ft to 100 ft, (12) K25.2 sprinklers at 7 psi
 - c. Ordinary-Hazard, Group 2 Occupancy / HC-2: 0.20 gpm over 2500-sq. ft. area.
 - 1) For ceiling heights 30-60 ft, a 0.20 gpm over 2500 sq.ft. is required. Dry-Pipe to have remote area increased to 3500 sq.ft.
 - 2) For celling heights 60 ft to 100 ft, (12) K25.2 sprinklers at 7 psi (standard spray) or (6) K25.2 extended coverage sprinklers at 27 psi, but not less than the sprinkler manufactures requirements.

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- 3) Baggage Handling Areas shall also include a calculation of 10 sprinklers each with a minimum pressure of 14 psi. This calculation is in addition to the .20 / 2500 calculation per FM Global
- d. Extra-Hazard, Group 1 Occupancy / HC-3: 0.30 gpm over 2500-sq. ft. area for ceiling heights less than 30 ft.
- e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
- f. Special Occupancy Hazard: As determined by FM Global
- g. Rack storage: In accordance with NFPA 13 and FM Global.
- h. When two different occupancy hazards are adjacent to each other and are not separated by a wall or draft curtain, extend the design of the sprinkler system protecting the higher-hazard occupancy a minimum of 20ft (6.0m) in all directions beyond the perimeter of the higher-hazard occupancy area. (FM 2-0, 2.1.3.1.3)
- 4. Maximum Protection Area per Sprinkler: Per UL listing and FM Global
- 5. Minimum Sprinkler K-factor for standard spray sprinklers:
 - a. HC-1 up to 30 ft: 5.6k
 - b. HC-1 for 30-60 ft: 8.0k
 - c. HC-2 up to 60 ft: 8.0k
 - d. HC-3 up to 60 ft.: 11.2k

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- e. HC-1, HC-2, HC-3 over 60 ft: 25.2k
- 6. Maximum Protection Area per standard spray sprinklers:
 - HC-1 (up to 30 ft): 225 sq.ft.
 - 1) Minimum spacing of 7 ft.
 - 2) Maximum spacing of 15 ft.
 - 3) Minimum area of 64 sq.ft.
 - b. HC-1 (30-60 ft): 120 sq.f.t
 - 1) Minimum spacing of 8 ft.
 - 2) Maximum spacing of 12 ft.
 - 3) Minimum spacing of 80 sq.ft.
 - c. HC-2 (up to 30 ft): 130 sq.ft.
 - 1) Minimum spacing of 7 ft.
 - 2) Maximum spacing of 12 ft.
 - 3) Minimum area of 64 sq.ft.
 - 4) Baggage Handling / Sortation: 100 sq.ft. maximum
 - a) Minimum spacing of 8 ft
 - b) Maximum spacing of 10 ft.
 - c) Minimum area of 80 sq.ft.
 - d. HC-2 (30-60ft) 100 sq.ft.
 - 1) Minimum spacing of 8 ft
 - 2) Maximum spacing of 10 ft.
 - 3) Minimum area of 80 sq.ft.
 - e. HC-3 (up to 30 ft): 100 sq.ft.
 - 1) Minimum spacing of 8 ft.
 - 2) Maximum spacing of 12 ft.
 - f. Other Areas: According to FM Global recommendations unless otherwise indicated.
- 7. Total Combined Inside and Outside Hose-Stream Demand Requirement: According to FM Global unless otherwise indicated:
 - a. Light-Hazard Occupancies / HC-1 with sprinklers up to 60ft: 250 gpm
 - b. Light-Hazard Occupancies / HC-1 with sprinklers over 60 ft: 500 gpm

- c. Ordinary-Hazard Occupancies / HC-2 with sprinklers up to 60 ft: 250 gpm
- d. Ordinary-Hazard Occupancies / HC-2 with sprinklers over 60 ft.: 500 gpm
- e. Extra-Hazard Occupancies: 500 gpm
- 8. Inside Hose Allowance: Minimum of 100 gpm at standpipes
- 9.

1.5 SUBMITTALS

A. Product Data:

- 1. Provide for each type of product indicated.
- 2. Submittals to include specific manufactures. Where multiple items are identified on each sheet, it shall be clearly indicated the items proposed to be installed.
- 3. All equipment shall be FM Global approved.
- 4. Product data to be submitted at the same time as shop drawings for review.
- B. Shop Drawings: For fire sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
 - 2. Sprinkler layout Only. A submittal shall be provided to the architect indicating the sprinkler layout, its coordination with all other trades, and its type, color and finish. Drawing shall not include the sprinkler piping.
- C.
- D. Qualification Data: For qualified Installer
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction (AHJ), including hydraulic calculations. Shop drawings shall be submitted to the engineer of record for review and approval prior to the AHJ. It shall be the installing contractor's responsibility to submit shop drawings after coordination and with sufficient time to allow for a minimum of two reviews prior to fabrication and installation. The engineer of record is not responsible for delays in the project schedule due to insufficient scheduling by the contractor. Each review by the engineer of record to be a minimum of 10 working days. Shop drawings that do not include all required items will be returned Rejected. Resubmittals that do not include a response to each review comment will be returned Rejected.
- F. Welding certificates.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Field quality-control reports.
- I. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, providing layout, procurement, fabricating, and installing sprinkler systems. Base calculations on results of fire-hydrant flow test or annual fire pump test as applicable.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. FM Global Data Sheets.
- E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M. Pipe ends to be roll grooved.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. <u>Manufacturers</u>: 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. <u>Anvil International, Inc</u>.
 - b. <u>Corcoran Piping System Co</u>.
 - c. National Fittings, Inc.
 - d. <u>Shurjoint Piping Products</u>.
 - e. Tyco Fire & Building Products LP.
 - f. <u>Victaulic Company</u>.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. All equipment shall be FM approved.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psi where high pressure required.
- B. Check 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. <u>AFAC Inc</u>.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.

- h. Fire-End & Croker Corporation.
- i. Fire Protection Products, Inc.
- j. <u>Fivalco Inc</u>.
- k. <u>Globe Fire Sprinkler Corporation</u>.
- I. <u>Groeniger & Company</u>.
- m. Kennedy Valve; a division of McWane, Inc.
- n. Matco-Norca.
- o. Metraflex, Inc.
- p. <u>Milwaukee Valve Company</u>.
- q. Mueller Co.; Water Products Division.
- r. <u>NIBCO INC</u>.
- s. Potter Roemer.
- t. <u>Reliable Automatic Sprinkler Co., Inc</u>.
- u. <u>Shurjoint Piping Products</u>.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. <u>Venus Fire Protection Ltd</u>.
- y. <u>Victaulic Company</u>.
- z. Viking Corporation.
- aa. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig (1725 kPa) minimum
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.
- C. Bronze OS&Y 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. <u>Crane Co.; Crane Valve Group; Crane Valves</u>.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. <u>Milwaukee Valve Company</u>.
 - d. <u>NIBCO INC</u>.
 - e. United Brass Works, Inc.
 - f. <Insert manufacturer's name>.
 - 2. Standard: UL 262.
 - 3. Pressure Rating: 175 psig (1200 kPa) or 250 psig where required
 - 4. Body Material: Bronze.
 - 5. End Connections: Threaded.
- D. Iron OS&Y 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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. <u>American Valve, Inc</u>.
 - c. Clow Valve Company; a division of McWane, Inc.

- d. <u>Crane Co.; Crane Valve Group; Crane Valves</u>.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. <u>Hammond Valve</u>.
- h. <u>Milwaukee Valve Company</u>.
- i. <u>Mueller Co.; Water Products Division</u>.
- j. <u>NIBCO INC</u>.
- k. <u>Shurjoint Piping Products</u>.
- I. Tyco Fire & Building Products LP.
- m. United Brass Works, Inc.
- n. <u>Watts Water Technologies, Inc</u>.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig (1725 kPa) minimum
- 4. Body Material: Cast or ductile iron.
- 5. End Connections: Flanged or grooved.
- E. Indicating-Type 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. <u>Anvil International, Inc</u>.
 - b. Fivalco Inc.
 - c. <u>Global Safety Products, Inc</u>.
 - d. <u>Kennedy Valve; a division of McWane, Inc</u>.
 - e. <u>Milwaukee Valve Company</u>.
 - f. <u>NIBCO INC</u>.
 - g. <u>Shurjoint Piping Products</u>.
 - h. Tyco Fire & Building Products LP.
 - i. <u>Victaulic Company</u>.
 - 2. Standard: UL 1091.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 - 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 - 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
 - 1. Standard: "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psi where required
- B. Ball Valves:
 - 1. <u>Manufacturers</u>: 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. <u>Affiliated Distributors</u>.
 - b. <u>Anvil International, Inc</u>.
 - c. <u>Barnett</u>.
 - d. <u>Conbraco Industries, Inc.; Apollo Valves</u>.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. <u>FNW</u>.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. <u>Kitz Corporation</u>.
 - I. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. <u>Milwaukee Valve Company</u>.
 - o. <u>NIBCO INC</u>.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. <u>Victaulic Company</u>.
 - v. <u>Watts Water Technologies, Inc</u>.

2.6 SPECIALTY VALVES

- A. General Requirements:
 - 1. Standard: "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psig where required
 - 3. Body Material: Cast or ductile iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Automatic (Ball Drip) Drain Valves:
 - 1. <u>Manufacturers:</u> 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. <u>AFAC Inc</u>.

- b. <u>Reliable Automatic Sprinkler Co., Inc.</u>
- c. <u>Tyco Fire & Building Products LP</u>.
- 2. Standard: UL 1726.
- 3. Pressure Rating: 175 psig (1200 kPa) or 250 psig where required
- 4. Type: Automatic draining, ball check.
- 5. Size: NPS 3/4 (DN 20).
- 6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

- A. Flush-Type, Fire-Department Connection:
 - 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. <u>AFAC Inc</u>.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. <u>Guardian Fire Equipment, Inc</u>.
 - e. <u>Potter Roemer</u>.
 - 2. Standard: UL 405.
 - 3. Type: Flush, for wall mounting.
 - 4. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 5. Body Material: Corrosion-resistant metal.
 - 6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - 7. Caps: Brass, lugged type, with gasket and chain.
 - 8. Escutcheon Plate: Rectangular, chrome, wall type.
 - 9. Outlet: With pipe threads.
 - 10. Body Style: Horizontal
 - 11. Number of Inlets: Two
 - 12. Outlet Location: Back
 - 13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE, AUTO SPKR."
 - 14. Finish: Polished chrome plated
 - 15. Outlet Size: match pipe supplying FDC
- B. Free Standing FDC
 - 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. <u>AFAC Inc</u>.
 - b. <u>Elkhart Brass Mfg. Company, Inc</u>.
 - c. <u>GMR International Equipment Corporation</u>.
 - d. Guardian Fire Equipment, Inc.
 - e. <u>Potter Roemer</u>.
 - 2. Standard: UL 405.

- 3. Type: Free standing
- 4. Pressure Rating: 175 psig (1200 kPa) minimum.
- 5. Body Material: Corrosion-resistant metal.
- 6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- 7. Caps: Brass, lugged type, with gasket and chain.
- 8. Escutcheon Plate: Rectangular, Chrome
- 9. Outlet: With pipe threads.
- 10. Body Style: Horizontal
- 11. Number of Inlets: Two
- 12. Outlet Location: Back
- 13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE, AUTO SPKR."
- 14. Finish: Polished chrome plated
- 15. Outlet Size: match pipe supplying FDC

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
 - 1. <u>Manufacturers</u>: 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. <u>Anvil International, Inc</u>.
 - b. <u>National Fittings, Inc</u>.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. <u>Victaulic Company</u>.
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as required
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-T and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. <u>Reliable Automatic Sprinkler Co., Inc</u>.
 - c. Tyco Fire & Building Products LP.
 - d. <u>Victaulic Company</u>.
 - 2. Standard: "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as required.

- 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. <u>Potter Roemer</u>.
 - 2. Standard: UL 199.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 4. Body Material: Brass.
 - 5. Size: Same as connected piping.
 - 6. Inlet: Threaded.
 - 7. Drain Outlet: Threaded and capped.
 - 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. <u>Triple R Specialty</u>.
 - c. Tyco Fire & Building Products LP.
 - d. <u>Victaulic Company</u>.
 - e. <u>Viking Corporation</u>.
 - 2. Standard: "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as required.
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- E. Flexible, Sprinkler Hose Fittings:
 - <u>Manufacturers</u>: Subject to compliance with requirements:
 a. <u>FlexHead Industries, Inc</u>.
 - 2. Standard: UL 1474.
 - 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 4. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as required.
 - 5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

- A. <u>Manufacturers</u>: 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. AFAC Inc.
 - 2. <u>Globe Fire Sprinkler Corporation</u>.
 - 3. <u>Reliable Automatic Sprinkler Co., Inc.</u>
 - 4. Tyco Fire & Building Products LP.
 - 5. Venus Fire Protection Ltd.
 - 6. <u>Victaulic Company</u>.
 - 7. <u>Viking Corporation</u>.
- B. General Requirements:
 - 1. Standard: "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
 - 3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum or 300 psig (2070 kPa) as required
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767
 - 2. Nonresidential Applications: UL 199
 - 3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
 - 1. white
 - 2. Bronze.
 - 3. Painted.
 - 4. Black
 - 5. Special (as required by the Architect) Contractor to provide a line item cost for each special color.
- E. Special Coatings:
 - 1. ENT (Electroless Nickel PTFE)
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Plastic, white finish, one piece, flat.
 - 2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- G. Sprinkler Guards:
 - 1. <u>Manufacturers</u>: 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. <u>Reliable Automatic Sprinkler Co., Inc</u>.
 - b. <u>Tyco Fire & Building Products LP</u>.
 - c. Victaulic Company.

d. <u>Viking Corporation</u>.

- 2. Standard: UL 199.
- 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
 - 1. <u>Manufacturers</u>: 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. <u>ADT Security Services, Inc</u>.
 - b. <u>McDonnell & Miller; ITT Industries</u>.
 - c. <u>Potter Electric Signal Company</u>.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - 2. Standard: UL 346.
 - 3. Water-Flow Detector: Electrically supervised.
 - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 5. Type: Paddle operated.
 - 6. Pressure Rating: 250 psig (1725 kPa).
 - 7. Design Installation: Horizontal or vertical.
- C. Valve Supervisory Switches:
 - 1. <u>Manufacturers</u>: 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. <u>Fire-Lite Alarms, Inc.; a Honeywell company</u>.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. <u>Potter Electric Signal Company</u>.
 - d. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

A. <u>Manufacturers</u>: 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. <u>AMETEK; U.S. Gauge Division</u>.
- 2. Ashcroft, Inc.
- 3. <u>Brecco Corporation</u>.
- 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa)
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

- 3.1 WATER-SUPPLY CONNECTIONS
 - Α.
 - B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction and Engineer of Record prior to installation and shall be incorporated into the first submission of shop drawings
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13 and as noted on Contract Documents.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage. Drains, including piping, to be installed concealed in "public" spaces. Where necessary to install in public space, drain to be installed concealed and access panel with signage provided by the fire sprinkler contractor.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes. Maintain all code required clearances. Sprinkler

shop drawings shall include specific details to each item noted and clearly indicate dimensions for components.

- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13 and FM Global. Comply with requirements for hanger materials in NFPA 13 and FM Global.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with <u>manufacture</u> requirements for heating cables in Section 210533 "for UL listed Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation.".
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install ductile iron sleeve seals for piping penetrations of concrete walls and slabs.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors in all locations where this is installed exposed and not above a drop ceiling in a public space. Not required for back of house such as mechanical, electrical or baggage handling spaces.
- R. Where sprinkler piping is installed beneath baggage handling systems, the sprinkler piping shall be supported from the building structure, and not the baggage handling system.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- D. Institutional type sprinklers shall be installed in all Holding Cells, Search Rooms, Processing Interview Rooms, and associated Corridor serving such spaces, and the Sterile Corridor,
- E. Upright sprinklers installed in the Landside and Airside Building shall be installed in branchlines with minimum of 1 inch outlets and reducers. The 1 inch outlet along the branchlines is to permit future modifications. This applies throughout all spaces in both buildings.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, or free standing fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping. Labels to identify the piping and indicate flow direction from the water source. All wet-pipe, dry-pipe, bulk supply, and standpipe piping to be provided with labels. Labels to be red with white lettering. Labels to be provided at a maximum of 19 ft. intervals along piping.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."<u>NFPA 70 and 72.</u>

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

- B. Remove and replace sprinklers with paint or other debris other than factory finish.
- C. Refer to section 01 74_23 FL "Final Cleaning" for additional cleaning requirements.
- D. All piping to be primed and painted shall be prepared such as to remove any rust, grease, cutting oil, etc such that the piped can be properly primed.

3.10 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Wet-pipe sprinkler system, NPS 2 and smaller shall be the following:
 - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints. Roll grooves are permitted for schedule 40.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 1/2 to NPS 6 shall be the following:
 - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 2. Schedule 40 is an acceptable alternative to schedule 10.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers
 - 2. Rooms with Suspended Ceilings: Recessed sprinklers. Contractor to provide separate line-item per unit cost to upgrade from Recessed sprinklers to Concealed.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright sprinklers, dry sprinklers.
 - 5. Special Applications: Extended-coverage sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Recessed Sprinklers: white with white escutcheon. Black with black escutcheons where ceiling is painted black.
 - 2. Upright Sprinklers: Brass finish. Dry-Pipe upright sprinklers, sprinklers installed in the EPG and CCP buildings, to have corrosion resistant manufacture applied finish. Sprinklers
 - 3. Institutional as indicated in specification.
 - 4. Specialty colors as indicated by the Architect. Fire Sprinkler contractor shall identify cost per sprinkler of specialty color in contract.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinkler specialty pipe fittings.
 - 5. Sprinklers.
 - 6. Alarm devices.
 - 7. Pressure gages.

B. Related Sections:

- 1. Section 21_-12_-00 "Fire-Suppression Standpipes" for standpipe piping.
- 2. Section 21_-13_-13 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
- 3. Section 21_-31_-13 "Electric-Drive, Centrifugal Fire Pumps"

1.2 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure or 250 psig where required such as, but not limited to, Parking Garage.
- B. Delegated Layout: Design sprinkler system(s) using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction and engineer of record.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent at the fire pump discharge, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications: Refer to specification 21 13 13
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: Refer to specification 21 13 13
 - 4. Maximum Protection Area per Sprinkler: Per FM requirements:
 - 5. Maximum Protection Area per Sprinkler: Refer to specification 21 13 13

6. Total Combined Hose-Stream Demand Requirement: Refer to specification 21 13 13

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work. All pipe elevations shall be included and the pitch of piping shall be included. Low points of system to be identified and required drain.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- 1.7 QUALITY ASSURANCE
 - A. Installer Qualifications:
 - 1. Installer's responsibilities include layout, fabricating, coordinating and installing sprinkler systems. Base calculations on results of fire-hydrant flow test or existing fire pump test report (Parking Garage)
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - D. FM Global

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Schedule 40, Galvanized Black-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method. (Schedule 10 is not permitted).
- B. Steel Pipe Nipples: Galvanized ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Steel Couplings: Galvanized ASTM A 865, threaded.
- D. Gray-Iron Threaded Fittings: Galvanized, ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. <u>Manufacturers</u>: 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. <u>Anvil International, Inc</u>.
 - b. <u>Corcoran Piping System Co</u>.
 - c. <u>National Fittings, Inc</u>.
 - d. <u>Shurjoint Piping Products</u>.
 - e. <u>Tyco Fire & Building Products LP</u>.
 - f. Victaulic Company.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. All equipment shall be FM approved.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psi as required
- B. Check 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. <u>AFAC Inc</u>.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. <u>Clow Valve Company; a division of McWane, Inc</u>.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. <u>Fivalco Inc</u>.
 - k. <u>Globe Fire Sprinkler Corporation</u>.
 - I. <u>Groeniger & Company</u>.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. <u>Matco-Norca</u>.
 - o. Metraflex, Inc.
 - p. <u>Milwaukee Valve Company</u>.
 - q. <u>Mueller Co.; Water Products Division</u>.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. <u>Victaulic Company</u>.
 - z. Viking Corporation.
 - aa. <u>Watts Water Technologies, Inc</u>.
 - 2. Standard: UL 312
 - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.
- C. Indicating-Type 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. <u>Anvil International, Inc</u>.

- b. <u>Fivalco Inc</u>.
- c. <u>Global Safety Products, Inc</u>.
- d. Kennedy Valve; a division of McWane, Inc.
- e. <u>Milwaukee Valve Company</u>.
- f. <u>NIBCO INC</u>.
- g. <u>Shurjoint Piping Products</u>.
- h. Tyco Fire & Building Products LP.
- i. <u>Victaulic Company</u>.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig (1200 kPa) minimum.
- 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: threaded or grooved
- 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
- 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.
- 2.5 TRIM AND DRAIN VALVES
 - A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa).
 - B. Ball Valves:
 - 1. <u>Manufacturers</u>: 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. <u>Affiliated Distributors</u>.
 - b. Anvil International, Inc.
 - c. <u>Barnett</u>.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. <u>Fire Protection Products, Inc</u>.
 - g. Flowserve.
 - h. <u>FNW</u>.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. <u>Kitz Corporation</u>.
 - I. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. <u>Milwaukee Valve Company</u>.

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- o. <u>NIBCO INC</u>.
- p. <u>Potter Roemer</u>.
- q. <u>Red-White Valve Corporation</u>.
- r. Southern Manufacturing Group.
- s. Stewart, M. A. and Sons Ltd.
- t. <u>Tyco Fire & Building Products LP</u>.
- u. <u>Victaulic Company</u>.
- v. <u>Watts Water Technologies, Inc</u>.

2.6 SPECIALTY VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa) or 250 psig as necessary
 - 3. Body Material: Cast or ductile iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Dry-Pipe 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. AFAC Inc.
 - b. <u>Globe Fire Sprinkler Corporation</u>.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. <u>Victaulic Company</u>.
 - g. Viking Corporation.
 - 2. Standard: UL 260
 - 3. Design: Differential-pressure type.
 - 4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - 5. Air Compressor:
 - 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) Gast Manufacturing Inc.
 - 2) <u>General Air Products, Inc,</u>
 - 3) <u>Viking Corporation</u>.
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.

- 2.7 FIRE-DEPARTMENT CONNECTIONS
 - A. See 21 13 13.
- 2.8 SPRINKLER SPECIALTY PIPE FITTINGS
 - A. General Requirements for Dry-Pipe-System Fittings: UL listed and FM Global approved for drypipe service.
 - B. Flow Detection and Test Assemblies:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. <u>Reliable Automatic Sprinkler Co., Inc</u>.
 - c. <u>Tyco Fire & Building Products LP</u>.
 - d. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum or 250 psig as required
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
 - C. Sprinkler Inspector's Test Fittings:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. <u>Triple R Specialty</u>.
 - c. <u>Tyco Fire & Building Products LP</u>.
 - d. <u>Victaulic Company</u>.
 - e. <u>Viking Corporation</u>.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum or 250 psig as required
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
 - D. Flexible, Sprinkler Hose Fittings:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. FlexHead Industries, Inc.

- 2. Standard: UL 1474.
- 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
- 4. Pressure Rating: 175 psig (1200 kPa) minimum or 250 gpm as required
- 5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

- A. <u>Manufacturers</u>: 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. AFAC Inc.
 - 2. <u>Globe Fire Sprinkler Corporation</u>.
 - 3. <u>Reliable Automatic Sprinkler Co., Inc.</u>
 - 4. Tyco Fire & Building Products LP.
 - 5. Venus Fire Protection Ltd.
 - 6. Victaulic Company.
 - 7. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig or 250 psig as required
 - 3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199
 - 2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application. Refer to 21 13 13 for additional requirements on minimal K-Factor Size based upon FM Global requirements.
- D. Sprinkler Finishes:
 - 1. White
 - 2. Black
 - 3. Bronze.
 - 4. Painted.
- E. Special Coatings:
 - 1. Corrosion-resistant paint.
 - 2. Victauilic VC-250
 - 3. Polyester
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

- 1. Ceiling Mounting: Plastic, white finish, one piece, flat (Black where black ceilings provided)
- 2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- 3. Special Color: Where indicated by the Architect
- G. Sprinkler Guards:
 - 1. <u>Manufacturers</u>: 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. <u>Reliable Automatic Sprinkler Co., Inc</u>.
 - b. <u>Tyco Fire & Building Products LP</u>.
 - c. <u>Victaulic Company</u>.
 - d. <u>Viking Corporation</u>.
 - 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
 - 1. <u>Manufacturers:</u> 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. <u>Globe Fire Sprinkler Corporation</u>.
 - b. <u>Tyco Fire & Building Products LP</u>.
 - c. <u>Victaulic Company</u>.
 - d. <u>Viking Corporation</u>.
 - 2. Standard: UL 753.
 - 3. Type: Mechanically operated, with Pelton wheel.
 - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - 5. Size: 10-inch (250-mm) diameter.
 - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - 7. Inlet: NPS 3/4 (DN 20).
 - 8. Outlet: NPS 1 (DN 25) drain connection.
- C. Valve Supervisory Switches:
 - 1. <u>Manufacturers:</u> 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. <u>Fire-Lite Alarms; a Honeywell company</u>.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. <u>Potter Electric Signal Company</u>.
 - d. <u>System Sensor; a Honeywell company</u>.

- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

- A. <u>Manufacturers</u>: 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. <u>AMETEK, Inc.; U.S. Gauge Division</u>.
 - 2. Ashcroft, Inc.
 - 3. <u>Brecco Corporation</u>.
 - 4. <u>WIKA Instrument Corporation</u>.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

A. Refer to 21 13 13.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction and Engineer of Record. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage. These shall be identified on the shop drawings.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Drain dry-pipe sprinkler piping.
- N. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices, air compressors.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- R. All piping to be pitched as required for drainage. Pipe to be pitched a minimum of ½" per 10'. Fire Sprinkler shop drawings shall indicate the direction of the pitch, including the maximum high points and low points of the sprinkler dry-pipe system.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- D. Dry-Pipe sprinkler systems located outside the building, including all at the Airside Concourse Building and Landside Terminal Building (ASC and LST) shall be provided with UL and FM approved corrosion resistant sprinklers. Sprinklers to be of High-Temperature.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Refer to 21 13 16.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping. Refer to 21 13 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."<u>NFPA 70 and 72</u>

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Dry-pipe sprinkler system, NPS 2 and smaller shall be the following:
 - 1. Schedule 40, black-steel pipe with cut-grooved ends; grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- C. Dry-pipe sprinkler system, NPS 2-1/2 to NPS 6 shall be the following:

1. Schedule 40, black-steel pipe with cut-grooved ends; grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers
 - 2. Rooms with Suspended Ceilings: Dry pendent sprinklers, Dry recessed sprinklers
 - 3. Wall Mounting: Dry sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - Recessed Sprinklers: white, with white escutcheon. Upright Sprinklers: white with corrosion resistant covering where installed outside of building.

END OF SECTION 211316

SECTION 212200 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. This specification outlines the requirements for a "Total Flood" of Halocarbon Clean Agent Fire Suppression System FK-5-1-12 with automatic detection and control. The work described in this specification includes all engineering, labor, materials, equipment, and service necessary and required, to complete and test the suppression system.

SUMMARY

- A. Section Includes:
- 1. Piping and piping specialties.
- 2. Extinguishing-agent containers.
- 3. Extinguishing agent.
- 4. Detection and alarm devices.
- 5. Control and alarm panels.
- 6. Accessories.
- 7. Connection devices for and wiring between system components.
- 8. Connection devices for power and integration into building's fire-alarm system.

1.2 APPLICABLE STANDARDS AND PUBLICATIONS

- A. The design, equipment, installation, testing, and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards:
- 1. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
 - b. NFPA 70: National Electrical Code
 - c. NFPA 72: National Fire Alarm and Signaling Code
 - d. NFPA 75: Standard for the Fire Protection of Information Technology Equipment
 - e. NFPA 76: Standard for the Fire Protection of Telecommunications Facilities
- 2. Factory Mutual Systems (FM) Publication
 - a. Factory Mutual Approval Guide
- 3. Underwriters Laboratories, Inc. (UL) Publication
 - a. UL 217: Standard for Single and Multiple Station Smoke Alarms
 - b. UL 228: Standard for Door Closers-Holders, With or Without Integral Smoke Detectors
 - c. UL 268: Smoke Detectors for Fire Alarm Systems
 - d. UL 268A: Standard for Smoke Detectors for Duct Application
 - e. UL 521: Standard for Heat Detectors for Fire Protective Signaling Systems
 - f. UL 864: Standard for Control Units and Accessories for Fire Alarm Systems
 - g. UL 1638: Standard for Visual Signaling Appliances Private Mode Emergency and General Utility Signaling
 - h. UL 1971: Standard for Signaling Devices for Hearing Impaired
- 4. Requirements of the Authority Having Jurisdiction (AHJ)
- B. RELATED DOCUMENTS
- 1. Drawings: The contract drawings indicate the general arrangements of the areas to receive detection and FK-5-1-12 protection. Contractor is to review all drawings so that all items affecting the operation of the fire detection/ FK-5-1-12 suppression system (such as equipment location, air diffusers, damper closures, and door openings) are considered in the design of the engineered system.

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
- 1. Product Data for Credit EA 4: Documentation indicating that clean agents comply.
- C. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.
- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include design calculations.
- 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 4. Wiring Diagrams: For power, signal, and control wiring.

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1.4 INFORMATIONAL SUBMITTALS

- A. The installing contractor shall submit the following design information and drawings for approval prior to starting work on this project:
 - 1. Permit Approved Drawings: Installation Shop Drawings, prepared according to NFPA 2001 Section 5.1.2.2, that have been approved by authorities having jurisdiction. Field installation shop drawings shall Include design calculations and detail the location of all agent storage tanks, nozzles, pipe runs, including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.
 - 2. A Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for the engineered clean agent systems design. Flow Calculation sheet(s) must comply with NFPA 2001 Section 5.2. Total agent discharge time and total flooding Quantity must be shown and detailed by each protected area.
 - 3. Provide calculations for the battery stand-by power supply, taking into consideration the power requirements of all alarms, initiating devices, and auxiliary components under full load conditions.
 - 4. A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay, and agent discharge for each protected area or system designed.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. MANUFACTURER:
 - 1. The manufacturer of the suppression system hardware and detection components shall be ISO 9001 registered.
 - 2. All devices, components, and equipment shall be the products of the same manufacturer,
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. All devices, components, and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.
 - 5. Locks for all cabinets shall be keyed alike.
 - 6. All devices and equipment shall be UL listed and/or FM approved.
- B. INSTALLER:
- 1. The installing contractor shall be trained by the supplier to design, install, test, and maintain fire suppression systems.
- 2. The clean agent contractor must have a minimum of five years' experience in the design, installation, and testing, of clean agent, or similar fire suppression systems, in strict accordance with all applicable codes and standards. The contractor personnel shall be trained and certified by the supplier manufacture and shall have a minimum NICET level III certified designer for Special Hazard, who will be responsible for this project

PART 2 - PRODUCTS

2.1 CLEAN-AGENT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide a Halocarbon Clean Agent FK-5-1-12 as indicated

on Drawings. Available manufacturers offering products that may be incorporated into the Scope of Work include, but are not limited to, the following:

- 1. Ansul Incorporated.
- 2. Chemetron Fire Systems; a UTC Fire & Security company.
- 3. Fike Corporation.
- 4. Pem All Fire Extinguisher Corporation; a division of Pem Systems Inc.
- 5. Pyro-Chem.
- 6. Siemens Building Technologies, Inc.; Fire Safety Division.
- B. Hazard Design: Halocarbon clean-agent FK-5-1-12 fire-extinguishing system must be design for Class C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas and obtain approval from authorities having jurisdiction.
- C. Performance Requirements: Discharge FK-5-12 within 10 seconds and maintain a minimum 4.5% percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas as defined by NFPA 2001 Chapter 5. The general contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10-minute "hold" period.
- D. System Operating Sequence:

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- 1. Actuating First Detector: Visual indication at Fire Alarm Control Unit (FACU) as Supervisory Signal. Energize audible and visual alarms (slow pulse horn) and Visual Appliances (If apply), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send Supervisory signal to building main fire-alarm system.
- 2. Actuating Second Detector: Visual indication at Fire Alarm Control Unit (FACU) as Alarm Signal. Energize audible and visual alarms (Continuous Horn), Close dampers associated with air-conditioning and ventilating systems at the protected area, start time delay countdown for extinguishing-agent discharge for 30 seconds, and send Alarm signal to building main fire-alarm system.
- 3. After "Time Delay" Cycle Ends: Halocarbon FK-5-1-12 Extinguishing-agent system discharge will operate all audible/ visual notification appliances inside and outside the protected area.
- 4. Manual Release Station shall activate visual indication at Fire Alarm Control Unit (FACU) as Alarm Signal. Energize and operate all audible/ visual notification appliances inside and outside the protected area, shut down air-conditioning and ventilating systems serving, Close associated dampers in the protected areas and immediately discharge extinguishing agent and send Alarm signal to building main fire-alarm system.
- 5. Operating abort switches will delay extinguishing-agent discharge while being activated, and (FACU) must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired and send Supervisory signal to building main fire-alarm system.
- 6. Operating Maintenance Switches shall activate visual indication at Fire Alarm Control Unit (FACU) as Trouble Signal. Disconnect Clean Agent Release Circuit and send Trouble Signal to building main fire-alarm system.

2.2 PIPING MATERIALS

- A. Distribution piping and fittings shall be installed in accordance with the manufacturer's requirements, NFPA 2001, and approved piping standards and guidelines. All distribution piping shall be installed by NICET qualified individuals using accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.
- B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section 4.2 "Distribution," for charging pressure of system.

2.3 PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A ; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
- 1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
 - c. Fittings Working Pressure: 820 PSI PSI MINIMUM
 - d. Flanged Joints: Class 300 minimum.
- 2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
- 3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
- 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile iron bousing, rubber gasket, and steel bots and puts

2.4 VALVES

- A. General Valve Requirements:
- 1. UL listed or FM Approved for use in fire-protection systems.
- 2. Compatible with type of clean agent used.
- B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
- C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
- D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

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2.5 EXTINGUISHING-AGENT CONTAINERS

- A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
- 1. Finish: Red enamel or epoxy paint.
- 2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
- 3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
- 4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
- 5. Liquid Level Indicator: Integral to each tank, to facilitate verification of agent levels.

2.6 FIRE-EXTINGUISHING CLEAN AGENT

- A. FK-5-1-12 Clean Agent: Dodecafluoro-2-methypentan-3-one
- 1. <u>Manufacturers:</u> Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ansul, Inc.
 - b. Chemetron Fire Systems.
 - c. Kidde Fire Systems
 - d. Pyro-Chem
 - e. Siemens Industry, Inc.
 - f. Viking Corp.

2.7 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application. Nozzles must comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.8 CONTROL PANELS

- A. Description: UL Listed , FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
- B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
- C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
- 1. Mounting: Surface mounted.
- D. Supervised Circuits: Separate circuits for each independent hazard area.
- 1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
- 2. Manual pull-station circuit.
- 3. Alarm circuit.
- 4. Release circuit.
- 5. Abort circuit.
- 6. EPO circuit.
- E. Control-Panel Features:
- 1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
- 2. Automatic switchover to standby power at loss of primary power.
- 3. Storage container, low-pressure indicator.
- 4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
- F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.
- G. Standby Power: Sealed lead calcium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged.

2.9 DETECTION DEVICES

A. General Requirements for Detection Devices:

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- 1. Comply with NFPA 2001, NFPA 72, and UL 268.
- 2. 24-V dc, nominal.
- B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
- C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
- D. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the building fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the building fire alarm control panel as separately identified zones.

2.10 MANUAL STATIONS

- A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, low voltage compatible with Fire Alarm Controls Units. Include contacts for connection to control panel.
- B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
- C. Abort Switch: "ABORT" caption, momentary contact, with green finish.
- D. EPO Switch: "EPO" caption, with yellow finish.

2.11 SWITCHES

- A. Description: FM Approved or NRTL listed, where available, 120V AC or low voltage compatible with Fire Alarm Control Unit. Include contacts for connection to control panel.
- 1. Low-Agent Pressure Switches: Pneumatic operation.
- 2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
- 3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.12 ALARM DEVICES

- A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Section 28_31_0011 "Digital, Addressable Fire_Detection and -Alarm System" or Section 283112 "Zoned (DC Loop) Fire-Alarm System" for alarm and monitoring devices.
- B. Bells: Minimum 6-inch diameter.
- C. Horns: 90 to 94 dBA.
- D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installing Contractor present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance. Proceed with installation only after unsatisfactory conditions have been corrected
- 3.2 FK-5-1-12 agent PIPING APPLICATIONS
 - A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
 - B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
 - C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints

3.3 CLEAN-AGENT PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.
- B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- C. Install extinguishing-agent containers anchored to substrate.
- D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
- 1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
- 2. Support piping using supports and methods according to NFPA 13.

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- 3. Install seismic restraints for extinguishing-agent containers and piping systems.
- 4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
- E. Drawings indicate general arrangement of piping, fittings, and specialties.
- F. Where installing piping adjacent to equipment, allow space for service and maintenance.
- G. Connect electrical devices to Fire Alarm control unit (Releasing Panel) and to building's main fire-alarm system.
- H. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- I. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a cleanagent fire-extinguishing system.
- J. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.4 FIELD QUALITY CONTROL

- A. 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. Perform field-acceptance tests of each clean-agent extinguishing system when installation is complete. Perform system testing only after hazard-area enclosure construction has been completed and openings sealed. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations
- C. Tests and Inspections:
- 1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
- 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
- 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Units will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices

3.6 SYSTEM FILLING

- A. Preparation:
- 1. Verify that piping system installation is completed and cleaned.
- 2. Check for complete enclosure integrity.
- 3. Check operation of ventilation and exhaust systems.
- B. Filling Procedures:
- 1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
- 2. Install filled extinguishing-agent containers.
- 3. Energize circuits.
- 4. Adjust operating controls.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

END OF SECTION 212200

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SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Horizontal Split-case fire pumps.
 - 2. Fire-pump accessories and specialties.

1.2 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 250 psig minimum unless higher pressure rating is indicated. Note, discharge from each fire pump is in excess of 175 psi.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each fire pump, from manufacturer.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."
- C. FM Global
- 1.7 COORDINATION
 - A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

- 2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS
 - A. Description: Factory-assembled and -tested fire-pump and driver unit.
 - B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
 - C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.2 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or one of the following:
 - 1. <u>A-C Fire Pump Systems; a business of ITT Industries</u>.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - 4. <u>Peerless Pump, Inc</u>.
 - 5. <u>Pentair Pump Group; Aurora Pump</u>.
 - 6. <u>S.A. Armstrong Limited</u>.
- C. Pump:
 - 1. Standard: UL 448 for split-case pumps for fire service.
 - 2. FM GLOBAL approved
 - 3. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - 4. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - 5. Wear Rings: Replaceable bronze.
 - 6. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.

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- b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
- 7. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- D. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- E. Driver:
 - 1. Standard: UL 1004A
 - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- F. Landside Fire Pump: Capacities and Characteristics:
 - 1. Rated Capacity: 1500 gpm
 - 2. Total Rated Head: 150 psi
 - 3. Inlet Flange: Class 125
 - 4. Outlet Flange: Class 250
 - 5. Motor Horsepower: 200
 - 6. Electrical Characteristics:
 - a. Volts: 460.
 - b. Phase: Three.
 - c. Hertz: 60.
- G. Airside Fire Pump: Capacities and Characteristics:
 - 1. Rated Capacity: 1500 gpm
 - 2. Total Rated Head: 150 psi
 - 3. Inlet Flange: Class 125
 - 4. Outlet Flange: Class 250
 - 5. Motor Horsepower: 200
 - 6. Electrical Characteristics:
 - a. Volts: 460.
 - b. Phase: Three.
 - c. Hertz: 60.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
- C. Relief Valves: Description: UL 1478, bronze or cast iron, spring loaded; for installation in firesuppression water-supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

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- F. Variable speed controller with automatic transfer switch to be provided at both the Landside and Airside.
- G. Discharge Cone: Closed or open type.
- H. Hose Valve Manifold Assembly:
 - 1. Standard: Comply with requirements in NFPA 20.
 - 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 - 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 - 4. Automatic Drain Valve: UL 1726.
 - 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; round.
 - d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
 - e. Exposed Parts Finish: chrome plated.
 - f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
- 2.4 GROUT
 - A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - B. Characteristics: Nonshrink and recommended for interior and exterior applications.
 - C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
 - D. Packaging: Premixed and factory packaged.
- 2.5 SOURCE QUALITY CONTROL
 - A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
 - B. Fire pumps will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 and FM Global for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in 033053 "Miscellaneous Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20 and FM Global.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fireprotection valves specified in Section 21_13_13 "Wet-Pipe Sprinkler Systems."
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified Section 21_13_13 "Wet-Pipe Sprinkler Systems."
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20 and FM Global.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- J. Engage a factory-authorized service representative to perform startup service.

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- 1. Complete installation and startup checks according to manufacturer's written instructions.
- 2. Factory authorized service representative shall be contracted by the fire sprinkler contractor at a minimum for fire pump pre-testing and final testing with the Authority Having Jurisdiction. All items found not in compliance during pre-testing shall be corrected during pre-testing.

3.3 ALIGNMENT

- A. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 21_13_13 "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect fire pumps to their controllers.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.6 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motordriver fire-pump controllers per the manufacture.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. All fire pumps shall be pretested with the manufacture's field agent

and determined to be acceptable prior to final commissioning. Fire pump field agent shall also be engaged for final commissioning with the fire marshall. Fire Sprinkler contractor shall include in base bid. All retesting necessary shall include the manufactures agent at no addental cost to the owner.

- D. Tests and Inspections:
 - 1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 213113

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.
 - 12. Excavation and backfill.
 - 13. Underground piping support.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

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- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: Product data includes the manufacturer's printed literature. <u>ALL</u> equipment, material, product and performance data shall be <u>CLEARLY</u> marked to specifically identify the item(s) being submitted for inclusion in this project. Non-pertinent data shall be deleted or marked through. Any and all deviations from the requirements of the Contract Documents shall be specifically listed, and clearly shown in the submittal. Any deviations not specifically disclosed in the submittal shall be solely at the risk of the Contractor, and shall be subject to discovery at any time. Any undisclosed deviations shall be corrected by the Contractor to comply with the requirements of the Contract Documents at no additional cost to the Owner, regardless of the acceptance of the submittal by the Architect/Engineer. Submit for the following under this section:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.
- C. Shop Drawings: Shop drawings include piping system layouts, fabrication and installation drawings of supports and anchorage for materials and equipment, and coordination drawings. Shop drawings also include proposed equipment layouts, drawn to scale, indicating that proposed equipment will fit into allotted space, including service access, connections, etc.
- D. Piping Systems: Submit shop drawings for piping systems drawn at a minimum scale of ¼ inch per foot on reproducible transparencies to verify clearances and equipment locations. Show required maintenance and operational clearances. Include the following:

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- 1. Fabrication and erection dimensions.
- 2. Sleeve layout plan for all penetrations through the post tensioned concrete structure.
- 3. Arrangements and sectional views.
- 4. Details, including complete information for making connections to equipment.
- 5. Descriptive names of equipment
- 6. Modifications and options to standard equipment required by Contract Documents.
- E. Product Data: Product data includes the manufacturer's printed literature.
- F. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements LEED V4 BD+C".
 - 1. Product Data: Documentation for Leadership Extraction Practices in the following:
 - a. Regional/Local Multiplier Compliance
 - b. Extended Producer Responsibility
 - c. Leadership Extraction Practices for Recycled Content
 - 2. Product Data: Documentation for Low Emitting Materials
 - a. Low Emitting Materials for Paints and Coatings
 - b. Low Emitting Materials for Adhesives and Sealants
 - 3. Product Certificates: Provide the following:
 - a. Environmental Product Declarations (EPD's)
 - b. Corporate Sustainability Reporting (CSR's)
 - c. Health Product Declarations (HPD's)
- G. Performance Data: Provide performance data, wiring and control diagrams.
- H. Installation Instructions: Installation instructions include detailed information, from the manufacturer, indicating specific installation requirements, instructions, and recommendations. Generic installation instructions are not acceptable. Instructions shall be the same as those included with the product when it is shipped from the factory.
- I. Written Operating Instructions: Operating instructions shall be the manufacturer's written operating instructions for the specified product. If the instructions cover more than one model or type of product they shall be clearly marked to identify the instructions that cover the product delivered to the project.
- J. Maintenance Instructions: Maintenance instructions shall be the manufacturer's printed instructions and parts lists for the equipment furnished. If the instructions cover more than one model or type of equipment they shall be marked to identify the instructions for the furnished product.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding:
 - 1. Comply with provisions in ASME B31.9, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current. Submit copy of welding procedures.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified.
- D. Code Compliance: Comply with all rules, laws, statutes, regulations, building codes, and the amendments of local, state and federal governments by the authorities having jurisdiction.
- E. ADA: Comply with the requirements of the Americans with Disabilities Act (ADA).
- F. HANDICAP ACCESS: Comply with Chapter 553, Part V, Florida Statutes, "ACCESSIBILITY BY HANDICAP PERSONS"; and the accessibility requirements manual from the Florida Board of Building Codes and Standards, Department of Community Affairs, latest Revisions.
- G. NFPA: Comply with the National Fire Codes compiled by the National Fire Protection Association.

1.6 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 plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

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- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section <u>08 31 13</u> "Access Doors and Frames."

1.8 DRAWINGS AND SPECIFICATIONS

- A. Equipment Placement: The drawings are diagrammatic, intended to show general arrangement, capacity and location of various components, equipment and devices. Reasonable changes in locations ordered by the Designer prior to the installation may be made at no additional cost.
- B. Drawing Scale: Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets, transitions and fittings may not be shown but shall be provided at no additional cost.

1.9 MANUFACTURER'S EQUIPMENT AND SYSTEMS STARTUP AND PERFORMANCE CHECKOUT

A. At the completion of installation, and in coordination with the CxA, a factory trained representative of the equipment manufacturer shall provide start-up and checkout services. The manufacturer's representative shall examine performance information and check the equipment in operation, and sign "Check-Out Memo", (Exhibit E in Section 01 78 00 <u>"Closeouts Submittals"</u>). Submit a copy of the Memo for each item of equipment where indicated in individual sections of these specifications. Include a copy of the Memo in each Technical Information Brochure Binder. The "Check-Out Memo" shall be included with the performance verification data. Do not request "Instruction in Operation Conference" or request final inspection until Memos have been submitted and are acceptable to the Designer.

1.10 INSTRUCTION TO THE OWNER

A. General: In coordination with the CxA and Section 01 91 13 <u>"</u>General Commissioning Requirements", Instructions to the Owner shall be accomplished by representatives of the manufacturers involved. Allow time for complete coverage of all operating procedures. Provide classroom instruction and field training in the design, operation and maintenance of the equipment and troubleshooting procedures. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar provisions of the systems. On the date of substantial completion, turn over the prime

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responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel.

- B. Training Period: Training period shall encompass a minimum of 8 hours of classroom and 8 hours of hands-on instructions with a maximum period of 4 hours per day. The training sessions shall be video recorded and turned over to GOAA for future use.
- C. Scheduling: Submit any remaining required items for checking at least one week before final inspection of the work. When submittal items are found acceptable, notify the Owner, in writing, that an "Instruction Conference" may proceed. Conference will be scheduled by the Owner. After the conference, copies of a memo certifying that the "Instruction Conference" and "Completed Demonstration" have been made will be signed by the Owner and the instructors, and one copy will be inserted in each submittal binder.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specified Products: Manufacturer's names and product model numbers indicated on the drawings and in these specifications establish the type, style, quality, performance, and sound rating of the desired product. Listing of other manufacturers indicates that their equivalent products would be acceptable if they meet the specification requirements, the specific use and installation shown on the drawings, including space and clearance requirements, and the energy consumption and efficiency of the specified product.
- B. Space Requirements: All manufactured products furnished on this project must have the required space and service areas indicated in the manufacturer's printed literature or shown on their approved shop drawings. When the manufacturer does not indicate the space required for servicing the equipment, the space shown on the drawings or as required by the Designer must be provided.

2.2 MATERIAL AND EQUIPMENT

- A. General: Material and equipment used shall be produced by manufacturers regularly engaged in the production of similar items, and with a history of satisfactory use as judged by the Designer.
- B. Specified Equipment: Equipment shall be the capacity and types indicated. Equipment and material furnished shall be the manufacturer's standard item of production unless specified or required to be modified to suit job conditions. Sizes, material, finish, dimensions and the capacities for the specified application shall be published in catalogs for national distribution. Ratings and capacities shall be certified by a recognized rating

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bureau. Products shall be complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Compatibility: Material and equipment of one and the same kind, type or classification and used for identical or similar purposes shall be made by the same manufacturer. Where more than one choice is available, select the options which are compatible with other products already selected. Compatibility is a basic general requirement of product selection.

2.3 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents: sewage ejector discharge and domestic water.
 - 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and fullface or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

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- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for generalduty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.5 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - g. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
 - b. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

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- 2. Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
- E. Adapters:
 - 1. Tile-cast iron adapters with extra heavy cast iron hub and spigot type, equal to Josam Series 88700.

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature. Refer to specification section 22_07_00 PLUMBING INSULATION "Plumbing insulation".
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F. Shall be listed under ASSE Standard No. 1079.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.

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- e. Hart Industries, International, Inc.
- f. Watts Industries, Inc.; Water Products Div.
- g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.

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d. Victaulic Co. of America.

2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

- 1. Sleeves (Above Grade): Sleeves shall be mild steel pipe Schedule 40 sleeves built into assembly, sized to pass pipe and covering, leaving a clear space of 1/4 inch minimum between covering and sleeve, or Proset pipe penetration system
- 2. Sleeves Installed in Exterior Walls (Below Grade): Link-seal modular seal system, or Schedule 40 steel hot dipped galvanized after fabrication or cast iron. Fabricate the sleeve with 1/4 inch x 3 inch center flange (water stop) around the outside.
- 3. Floors (Above Grade): Sleeves shall be Schedule 10 galvanized steel. When copper or steel piping penetrates concrete slabs, use Proset System for fire-rated and water pipe installations.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chromeplated finish.

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- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi , 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.11 ROOF PENETRATIONS

A. Any penetrations, pipes, conduits, guy wire anchors, etc. which penetrate an existing roof membrane shall have the membrane protected per architectural documents and specifications. Pitch pockets will not be allowed.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and

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calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. 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 chromeplated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - 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 or splitcasting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

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- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
- j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
- I. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floorplate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install Link-seal modular seal system, or cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Use Proset pipe penetration system. Seal pipe penetrations with firestop materials. Refer to Division 07 Section <u>07 84 13</u> "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.

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T. Refer to equipment specifications in other Sections of these Specifications for roughingin requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Grooved Joints: Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on-site training to

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contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products

- J. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- K. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- L. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- M. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- N. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. 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 flange or grooved-joint couplingss, in piping NPS 2-1/2 and larger, adjacent to flanged or grooved-ended valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

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3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 MECHANICAL & PLUMBING EQUIPMENT ROOMS & CONDENSATE DRAINS

- A. Condensate from HVAC units shall be indirectly connected to a hard piped drain system via condensate floor drains with raised rim. Condensate drains shall connect into the storm system with a back water valve. For air handling unit drains, provide AC condensate trap of appropriate dimensions for operating pressure of the unit. Refer to details on HVAC drawings.
- B. When not feasible for gravity drainage connection into the storm system, shall dump into a concrete sump pit. Min size of pit shall be 16"x16"x18". Submersible condensate sump pumps shall be an Owner approved substitution to Liberty 247 VMF series shall be used. Provide float switch & warning system connected to BAS system to alarm in case of overflow. Also provide float switch in hard piped condensate trap from AC unit.
- C. When it is not feasible to install a sump pit (i.e when above an occupied floor), a premanufactured combination pump/basin secured in the corner of the HVAC closet. Use an Owner approved substitution to Liberty SPAC series sump pump package.
- D. The sump pit or pump basin will require a float switch which will turn off the respective fan coil in case of condensate overflow.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

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- 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
- 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section <u>03 30 00</u> "Cast-in-Place Concrete"

3.7 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections <u>09 91 23</u> "Interior Painting" and <u>09 91 13</u> "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Provide labor, materials, and equipment necessary for field prime painting. Protect flooring and equipment with drop cloths and store paint and materials in a location where directed. Using wire brush, remove oil, dirt, rust and grease before applying paint.
- D. Apply a heavy coat of bituminous solution paint on piping in concrete or cinder fill or exposed above roof and on underground joint clamps.
- E. Apply epoxy primer for steel piping, cast iron piping (except underground), and all steel and iron work.
- F. Dip in epoxy primer, uncoated hangers, supports, rods and inserts.
- G. Epoxy primer shall be Sherwin Williams product, or approved equal, in compliance with the requirements for Low Emitting Paints and Coatings.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section <u>05 50 00</u> "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

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3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place all new wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment. All wood shall be new fire rated products, scraps from the site shall not be used.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 EXCAVATION AND BACKFILL

- A. Excavate, backfill and restore surfaces beyond 5 ft. outside of building.
- B. If rock is encountered, excavate to 6 in. below bottom of piping and refill with well-tamped sand and gravel.
- C. Bank excavated materials adjacent to trench and properly support with sheet piling and braces.
- D. Install and maintain guards and keep excavation free of water with attendant pumping equipment.
- E. No extra compensation will be provided for quicksand, hardpan, or other material encountered in excavating, except rock on unit price basis.
- F. Remove bog or other swampy conditions encountered in excavating to 1 foot below bottom of piping and backfill with well tamped sand, finely crushed stone, or gravel.
- G. The trench width at top of pipe should not exceed the minimum size for the installed pipe diameter. Provide heavier pipe, concrete encasement or continuous concrete cradle due to extra weight of fill, if trench width is wider than minimum.
- H. Immediately after piping is installed, inspected, tested, and accepted, remove sheet piling with special care and solidly fill voids without injury to piping. Backfill in a manner to prevent future settlement. Use only good clean loam, clay, sand, or gravel that is free from frozen materials, lumps of clay, rocks, boulders, cinders, slag ashes, vegetable or organic materials, building or other debris, or refuse.
 - 1. Hand fill in 4 in. layers up to 2 ft. above pipe and remainder, fill in with 1 foot layers.
 - 2. Tamp each layer before placing next layer.
 - 3. Allow no stones larger than 2 in. in diameter in fill up to 2 ft. above piping and allow no stones larger than 4 in. in diameter in fill over 2 ft. above piping.

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- I. Restore to match existing surfaces, sidewalks, pavements, curbing, lawns, and shrubs that are disturbed or damaged.
- J. Dispose of acceptable surplus excavation on site and remove surplus and unsuitable excavated materials from site as directed.

3.11 UNDERGROUND PIPING SUPPORTS

- A. Support on solid undisturbed ground; or support on concrete, brick piers or cradles where there is unsuitable ground, at trench crossings, and when crossing excavation adjacent to building wall or foundations. Concrete supports must be engineered and submitted for approval.
- B. Bottom of trenches shall be tamped hard, graded for required pitch, shaped to give uniform support to lower third of full length of pipe, and with recesses excavated for bells and joints.
- C. Support and protect piping so it remains in place without settling or damage during and from backfilling. Replace any damaged pipe.

3.12 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.13 CLEANING AND PROTECTION

A. General: Refer to Division 01.

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- B. Housekeeping: Keep interiors of duct and pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping and ductwork at all times throughout the installation. Install 30% efficient filter media over each return air grille and open return duct opening; change media regularly during construction when dirty to keep duct interiors clean. Prevent dust, debris and foreign material from entering the piping and ductwork.
- C. Equipment Protection: Protect fan motors, switches, equipment, fixtures, and other items from dirt, rubbish and foreign matter. Do not operate air handling equipment if the building is not clean or if dust can enter the coils or the fan housings.
- D. Equipment Cleaning: Thoroughly clean equipment and entire piping systems internally upon completion of installation and immediately prior to Submittal Completion. Open dirt pockets and strainers, blow down each piping system and clean strainer screens of accumulated debris. Remove accumulated dirt, scale, oil and foreign substances.
- E. Fixture Cleanup: Remove temporary labels, stickers, etc., from fixtures and equipment. Do not remove permanent name plates, equipment model numbers, ratings, etc.
- F. Protection of Finished Installation: Where installation is required in areas previously finished by other trades, protect the area from marring, soiling or other damage.
- 3.14 CORRECTION OF WORK
 - A. General: At no additional cost to the Owner, rectify discrepancies between the actual installation and Contract Documents in the submittals when in the opinion of the Testing and Balancing Agency (T&B Agency) or the Designer the discrepancies will affect system balance and performance.
 - B. Drive Changes: Include the cost of all pulley, belt, and drive changes, as well as balancing valves and fittings, and access panels to achieve proper system balance recommended by the T&B Agency.

END OF SECTION 22 05 00

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
- B. Related Sections:
 - 1. Division 22 Section 221116—"Domestic Water Piping" for domestic and fireprotection water service meters inside the building.
 - 2. Division 23 Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

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D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components Health Effects; Sections 1 through 9" and Annex F & G for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Thermometer:

	Piping	Insulated	Uninsulated
a.	H.O. Trerice Co	A410	A410
b.	Weiss	9VS6	9VS3-1/2
c.	Weksler	AA5L-9	AA5L-9

2. Test Wells: Stainless steel with threaded plug or cap with chain, 1/2 inch NPT, and extension neck where necessary to extend above the insulation.

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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: CUNI
 - 4. Material for Use with Steel Piping: CSA.

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- 5. Type: Stepped shank unless straight or tapered shank is indicated.
- 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
- 7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), 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 thermowells internal screw thread to size of thermometer connection.

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

	Indoor	Outdoor
H.O. Trerice Co.	450B	650B
Weiss	4UGAN-1	
Weksler	BA141	BA14Y

- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Match pressure connection size in first subparagraph below with gage attachment size.
- 6. 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.
- 7. Movement: Mechanical, with link to pressure element and connection to pointer.
- 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 9. Pointer: Dark-colored metal.
- 10. Window: Glass.
- 11. Ring: Stainless steel.
- 12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- B. Pressure-Gage Fittings:
 - 1. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.
 - 2. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

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2.4 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. Sisco Manufacturing Co.
 - 4. Trerice, H. O. Co.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for water service at 20 to 200 deg F shall be CR.
 - 2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.
- E. Test Kit: Furnish four test kits containing one pressure gage and adaptor, two thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be 0 to 200 psig.
 - 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inchdiameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 - 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inchdiameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
 - 4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the outlet of each domestic, hot-water storage tank and where shown on drawings.
- B. Provide stainless steel separable socket in tank connections. On piping connection, provide in an oversized tee and nipple. Locate on each water heater, pre-heater, hot

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water tank, in outlet piping of each water heater and in outlet piping of each thermostatic tempering valve, hot water return piping, chilled water supply and return piping, and as noted.

- C. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 0 to 100 deg F, with 1-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install liquid-filled-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending a minimum of 2 inches into fluid or to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage.
- E. Install test plugs in tees in piping.
- F. Install permanent indicators on walls or brackets in accessible and readable positions.
- G. Install connection fittings for attachment to portable indicators in accessible locations.
- H. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- I. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 22 0519

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SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Bronze ball valves.
 - 3. Ductile-iron, single-flange butterfly valves.
 - 4. Ductile-iron, grooved-end butterfly valves.
 - 5. Iron, flanged butterfly valves.
 - 6. High-performance butterfly valves.
 - 7. Bronze lift check valves.
 - 8. Bronze swing check valves.
 - 9. Iron swing check valves.
 - 10. Iron, grooved-end swing check valves.
 - 11. Iron, center-guided check valves.
 - 12. Bronze gate valves.
 - 13. Iron gate valves.
 - 14. Lubricated plug valves.
 - 15. Chainwheels.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section <u>22 05 23</u> "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water <u>utility</u> distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

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- B. EPDM: Ethylene propylene diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. PTFE: Polytetrafluoroethylene plastic.
- F. OS&Y: Outside screw and yoke.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.
- B. All submitted valves must be manufactured in USA.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.

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- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

- 2.1 GENERAL REQUIREMENTS FOR VALVES
 - A. Refer to valve schedule articles for applications of valves.
 - B. 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.
 - C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
 - D. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
 - E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
 - F. Valve Sizes: Same as upstream piping unless otherwise indicated.
 - G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
 - H. 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

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or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

- 3. Butterfly Valves: With extended neck.
- I. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. 2" and smaller bronze ball valves
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 2 inch and smaller: 150 psi SWP, 400 psi WOG. Standard port ball, bronze trim, cast bronze body, chromium-plated brass ball, bronze non-blowout stem, Teflon seat, double o-ring stem seals, zinc-coated steel handle with plastic coated hand grip, 90 degree operation from full open to tight shut-off.

		Threaded	Solder Joint
1)	Nibco	T-585-70	S-585-70
2)	Jamesbury	300	
2	Viewe		

3) Viega

2.3 BUTTERFLY VALVES

- A. General: Valves shall be capable of bubble tight shut-off at pressure differentials of 150 psi. Valves in insulated piping shall have a minimum of 2 inch extended necks for insulation clearance.
- B. Operators: Valves 4 inch and smaller shall have steel lever latch-type actuator capable of infinite position (or minimum of 10 locking positions) and shall have adjustable memory stop. Valves 5 inch and larger shall have enclosed gear type actuator with chain wheel, hand wheel or crank type operating mechanisms, adjustable opening and closing memory stops, and position indicator. All valves 4 inch and larger located more than 7 feet above the floor or landing shall be provided with chain wheel and chain extending to within 12 inches above the floor or landing. Provide stem extensions (in addition to insulation)

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clearance extension) as required to place operators in an easily accessible location free of interference with adjacent piping, equipment structure, etc.

- C. 2 inch and smaller: Cast bronze body, viton seals, full port, stainless steel trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco
 - b. Centerline
 - c. De Zurik
- D. 2-1/2 inch and larger: Threaded and tapped lug, cast iron ASTM A126-B or ductile iron ASTM A-395 Class 60-40-18 body, bronze ASTM B-62, aluminum bronze or nylon coated disc, 416 stainless steel or phosphate coated steel shaft, and EPDM seat designed to seal against the companion flanges. Stem seals shall consist of a primary seal between the spherical disc hub and the spherical seat hub. Wafer-type are not permitted:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Centerline Series LT
 - b. De Zurik 660LR-S823
 - c. Nibco LD 2000
- E. Grooved Butterfly Valves: Ductile iron body, ductile iron disc EPDM encapsulated, stainless steel stem, minimum 300 psi working pressure:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Vic 300
 - b. Gruvlok Series 7000

2.4 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic PTFE or TFE Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-480-Y-LF or T-480-Y-LF or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:

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- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 584 Alloy C844, bronze.
- e. Ends: Threaded or Solder.
- f. Disc: PTFE, or TFE.

2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-B or T-413-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Y-pattern horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Buna-N Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-W or T-413-W or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Y-pattern horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: Buna-N.
- C. Class 125, Bronze Swing Check Valves with Nonmetallic TFE Disc:

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- 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-Y or T-413-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Y-pattern horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE or TFE.
- D. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-433-B or T-433-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Y-pattern horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: Bronze.
- E. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-433-Y or T-433-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Y-pattern horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.

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- f. Disc: PTFE or TFE.
- 2.6 IRON SWING CHECK VALVES
 - A. Class 125, Cast-Iron Swing Check Valves with Metal Seats:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-918-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - B. Class 150, Ductile-Iron Swing Check Valves with Metal Seats:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-9138-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell, Wm. Co.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 285 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 395, ductile iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Seat Ring: Asbestos free.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.
 - C. Class 250, Iron Swing Check Valves with Metal Seats:

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- 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-9138-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell, Wm. Co.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.7 IRON, GROOVED-END SWING CHECK VALVES

- A. 250 CWP, Iron, Grooved-End Swing Check Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model G-917-W or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell, Wm. Co.
 - 2. Description:
 - a. CWP Rating: 250 psig.
 - b. Body Material: Gray iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, stainless steel with EPDM.
- B. 200 CWP, Bronze, Silent Check Valve, Lead-Free
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-910-B or a comparable product by one of the following:
 - a. Metraflex.
 - b. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48, gray iron.

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- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Buna-N.
- g. Seat: Buna-N.
- h. Seat: Buna-N.

2.8 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-113 or T-113 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 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.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- B. Class 125, RS Bronze Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-111 or T-111 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

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- C. Class 150, NRS Bronze Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-136 or T-136 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- D. Class 150, RS Bronze Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-134 or T-134 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- E. Class 200, RS Bronze Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-154 or T-154 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:

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- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 400 psig.
- c. Body Material: ASTM B 61, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded or solder.
- e. Stem: Copper-silicon bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.9 IRON GATE VALVES

- A. Class 125, NRS, Cast-Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-619 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- B. Class 125, OS&Y, Cast-Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-617-O or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

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- C. Class 150, NRS, Ductile-Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-639-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 285 psig.
 - c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- D. Class 150, OS&Y, Ductile-Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-637-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 285 psig.
 - c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- E. Class 250, NRS, Cast-Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-699 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.

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- b. CWP Rating: 500 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.
- F. Class 250, OS&Y, Iron Gate Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-667-O or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-211-B or T-211-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 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.
 - e. Stem and Disc: Copper-silicon bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

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- 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-211-Y or T-211-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- C. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-235-Y or T-235-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Copper-silicon bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- 2.11 IRON GLOBE VALVES
 - A. Class 125, Iron Globe Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-718-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.

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- 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- B. Class 150, Iron Globe Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-738-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 285 psig.
 - c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- C. Class 250, Iron Globe Valves:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-768-B or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

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- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. Description:
 - c. Standard: MSS SP-78, Type II.
 - d. CWP Rating: 400 psig.
 - e. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - f. Pattern: Venturi.
 - g. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.

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- d. Pattern: Venturi.
- e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubricationsealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

2.13 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.

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- 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball butterfly and plug valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

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- F. Dielectric unions shall be provided on each side of threaded valves, check valves and circuit balancing valves, and on the upstream side of soldered valves, unions are not required on three piece full port ball valve.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe, ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

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- 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.
- 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 150, nonmetallic disc.
 - 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 4. Bronze Lift Check Valves: Class 125, nonmetallic TFE disc.
 - 5. Bronze Swing Check Valves: Class 150, nonmetallic TFE disc.
 - 6. Bronze Gate Valves: Class 150, RS.
 - 7. Bronze Globe Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Angle Valves: Class 125.
 - 3. Steel Ball Valves: Class 150, full-port.
 - 4. Ductile-Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminumbronze disc.
 - 5. Ductile-Iron, Grooved-End Butterfly Valves: 300 CWP.
 - 6. High-Performance Butterfly Valves: Class 150, 285 CWP.
 - 7. Iron Swing Check Valves: Class 125, metal seats.
 - 8. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
 - 9. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - 10. Iron, Center-Guided Check Valves: Class 125, globe, resilient seat.
 - 11. Iron, Plate-Type Check Valves: Class 125; dual plate; resilient seat.
 - 12. Iron Gate Valves: Class 125, OS&Y.
 - 13. Iron Globe Valves: Class 125.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 125, nonmetallic disc.
 - 4. Bronze Gate Valves: Class 150, RS.
- B. Pipe NPS 2-1/2 and Larger:

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- 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
- 2. Steel Ball Valves: Class 150, full port.
- 3. Iron Swing Check Valves: Class 125, metal seats.
- 4. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
- 5. Iron, Grooved-End Swing Check Valves: 300 CWP.
- 6. Iron Gate Valves: Class 125, OS&Y.

END OF SECTION 22 0523

SECTION 220533 - HEAT TRACING 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. This Section includes plumbing piping heat tracing for freeze prevention:
1. Self-regulating, parallel resistance.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: Line power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

E.F.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Raychem or a comparable product by one of the following:
 - 1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
 - 2. Delta-Therm Corporation.
 - 3. Pyrotenax; a division of Tyco Thermal Controls.
 - 4. Raychem; a division of Tyco Thermal Controls.
 - 5. Thermon Manufacturing Co.
- D. Heating Element: Pair of parallel No. 16AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- E. Electrical Insulating Jacket: Flame-retardant polyolefin.
- F. Cable Cover: Tinned-copperbraid, and polyolefin outer jacket with UV inhibitor.
- G. Maximum Operating Temperature (Power On): 150 deg F (65 deg C)
- H. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C.
- I. Capacities and Characteristics: As indicated on the drawings
 - 1. The heater, when exposed to temperatures up to 150 deg F, shall have power output which will continuously decrease or remain unchanged. An increase in power output with increasing temperature is unacceptable.
 - 2. Cable shall be permanently marked with manufacturer's batch or serial number for traceability and cable jackets shall be continuously and permanently marked

with manufacturer's name,

catalog number, and nominal supply voltage. Temporary printing or tags are unacceptable.

2.2 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:
 - Remote bulb unit with adjustable temperature range from 30 to 50 deg F (minus 1 to plus 10 deg C). <
 - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - 4. Corrosion-resistant, waterproof control enclosure.
 - 5. Auxiliary connection to BMS system
 - 6. Raychem HWATT-ECO.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Division 22 Section 220553—"Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
 - 1. Exposed drainage piping, water piping subject to freezing and drainage piping containing grease: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install electric heating cables according to IEEE 515.1.
 - Install insulation over piping with electric cables according to Division 22 Section <u>220719</u> "Plumbing Piping-Insulation."
 - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
 - 5. Specified following temperature must be maintained using only one type cable throughout system, regardless of pipe size:
 - a. 40 deg F for freeze protection of exposed drainage piping.
 - b. 100 deg F for grease waste stoppage protection with insulation.
- C. Set field-adjustable switches and circuit-breaker trip ranges.
- D. Protect installed heating cables, including nonheating leads, from damage.
- E. The manufacturer shall have over five years experience with self-regulating heater cable in the freeze protection application, and shall submit the names, locations, and telephone numbers of five projects that have used their product for five years or more. Each project shall involve at least 2,000 feet of heater cable.
- F. Manufacturer shall warranty the tracing material for a period of twenty four (24) months from date of shipment.

3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section <u>26 05 26</u> "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section <u>26 25 00 "Busway Low-Voltage"</u> Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 220533

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Calcium cilicate.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied fabric-reinforcing mesh.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
 - 11. Corner angles.
- B. Related Sections include the following:
 - 1. Division 23 Section 23 07 19 "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements – LEED V4 BD+C".
 - 1. Product Data: Documentation for Leadership Extraction Practices in the following:
 - a. Leadership Extraction Practices for Recycled Content.
 - 2. Product Data: Documentation for Low Emitting Materials.

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- a. Low Emitting Materials for Adhesives and Sealants.
- 3. Product Certificates: Provide the following:
 - a. Environmental Product Declarations (EPD's).
 - b. Corporate Sustainability Reporting (CSR's).
- C. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- E. Qualification Data: For qualified Installer.
- F. 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.
- G. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-testresponse characteristics indicated, as determined by testing identical products per

ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

- 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smokedeveloped index of 50 or less.
- 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smokedeveloped 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 Engineer. 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. Equipment Mockups: One tank or vessel.
 - 3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 4. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
 - 5. Obtain Engineer's approval of mockups before starting insulation application.
 - 6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 8. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

- B. Packages and standard containers of materials shall be delivered unopened to job site and shall have the manufacturer's label attached giving a complete description of the material.
- C. Refer to section 01 35 46 "Indoor Air Quality Management" for material storage protocol.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. All insulation, jackets and adhesives used shall comply with the requirements of ASTM E-84 with a maximum flame spread rating of 25 and a maximum smoke developed/fuel

contributed rating of 50. Insulation on piping exposed in boiler rooms, mechanical equipment rooms, air handling equipment rooms, etc. or exposed on the exterior of the building shall be cellular glass.

- 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Microlite.
 - b. Owens Corning; All-Service Duct Wrap.
- I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
 - c. Fibrex Insulations Inc.; FBX.

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- J. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. 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.
- K. Mineral-Fiber 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, provide one of the following:
 - a. Johns Manville; MicroFlex.
 - b. Knauf Insulation; Pipe and Tank Insulation.
 - c. Owens Corning; Fiberglas Pipe and Tank Insulation.
- L. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
 - b. Johns Manville; MicroFlex.
 - c. Promat Inc.
 - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, available manufacturer's products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Knauf insulation ECOSEAL Plus.
 - b. Tremco, Inc.
 - c. Owner Approved CDPH compliant Substitution.

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.
- B. Low Emitting Adhesives and Sealants
 - 1. Provide Manufacturer statements that confirm the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
 - 2. Refer to Section 01 81 13.14 "Sustainable Design Requirements LEED v4 BD+C" for additional requirements.
- C. 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.
 - b. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - For indoor applications, adhesive shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements – LEED v4 BD+C" for additional requirements.
- D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No.30-65.
 - b. Childers products No. CP-34.
 - c. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - 2. For indoor applications, adhesive shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements LEED v4 BD+C" for additional requirements.
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products No. CP-34.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. 30-65.

b.

- c. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
- 2. For indoor applications, adhesive shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements – LEED v4 BD+C" for additional requirements.
- F. 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-34.
 - b. Foster Products Corporation, H. B. Fuller Company No. 30-65.
 - c. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - 2. For indoor applications, adhesive shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements – LEED v4 BD+C" for additional requirements.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.
 - b. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.08 perm at 45-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg.
 - 4. Solids Content: ASTM D 1644, 48 percent by volume and 62 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.

- b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. 30-65.
- c. Mon-Eco Industries, Inc.
- d.
- e. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
- 2. Water-Vapor Permeance: ASTM E 96, 0.08 perms at 44 mils dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: 48% by volume and 62% by weight.
- 5. Color: White.
- D. For indoor applications, mastics shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements LEED v4 BD+C" for additional requirements.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. CP 34.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. CP 30-65.
 - c. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Permanently flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 5. Color: White or gray.
 - 6. For indoor applications, sealants shall comply with the requirements of section 01 81 13.14.
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. CP-34.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company No. CP 30-65.
 - c. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.

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- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 20 to plus 180 deg F.
- 5. Color: Aluminum.
- 6. For indoor applications, sealants shall comply with the requirements of section 01 81 13.14 "Sustainable Design Requirements – LEED V4 BC + D".
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.
 - b. Alternate product meeting specified requirements and the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario for indoor applications.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall comply with the requirements of section 01 81 13.14"Sustainable Design Requirements LEED V4 BC + D".

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.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
- b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Sheet and roll stock ready for shop or field sizing.
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - 2. Width: 3 inches.

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- 3. Thickness: 11.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.

- 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
- 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position

indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
- b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
- c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
- d. Adhesive-backed base with a peel-off protective cover.
- 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - 3) Owner approved substitution
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. C & F Wire.
- b. Childers Products.
- c. PABCO Metals Corporation.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. 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 equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield. Refer to Section 22 11 16 "Domestic Water Piping" for shield sizes.
- 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 (i.e. cold water, chilled water, insulated storm water, and other frost protected services), apply vapor-barrier mastic over staples.

- 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 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.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches.
 - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from galvanized steel, at least 0.0396 inch thick (20 Gage).
 - 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.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, 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, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. 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.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 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.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.

- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
- 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 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.

3.9 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 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.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. 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.
- D. Where PVDC jackets are indicated, install as follows:

- 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
- 2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
- 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
- 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
- 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Equipment and Pipe Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections 09 91 13"Exterior Painting" and 09 91 23 "Interior painting"

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- 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.
- C. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- D. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- E. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

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- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect and/or Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect and/or Engineer, 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.
- 3.13 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE
 - A. Round, exposed breeching and connector insulation: High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 - B. Round, concealed breeching and connector insulation: High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.

3.14 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 in paragraphs below that is not factory insulated.
- C. Domestic water pump insulation: Cellular Glass: 2 inches thick.
- D. Domestic water hydropneumatic tank insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Pipe and Tank: 1 inch thick.
- E. Domestic hot-water storage tank insulation: Mineral-fiber pipe and tank of thickness to provide an R-value of 12.5.
3.15 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, only where noted.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- C. Soundproof piping in walls and ceilings of as noted for insulation on respective service, except with a minimum 2 inch thick fiberglass, or as recommended by an acoustic consultant.

3.16 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water: Not required.
- B. Domestic Hot, Tempered, and Recirculated Hot and Tempered Water:
 - NPS 1-1/4 and Smaller: Insulation shall be the following:
 a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - NPS 1-1/2 and Larger: Insulation shall be the following:
 a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Storm water and Overflow: Insulation shall be the following: Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies: Insulation shall be the following:
 1. Flexible Elastomeric: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. Pre-formed insulation for ADA traps and fittings, equal to Procap.
- F. Condensate and Equipment Drain Water below 60 Deg F: Insulation shall be the following: Flexible Elastomeric: 3/4 inch thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg : Insulation shall be the following: Flexible Elastomeric: 3/4 inch thick.

- 3.17 OUTDOOR, EXPOSED, OR WITHIN AN EXPOSED PARKING GARAGE ABOVEGROUND PIPING INSULATION SCHEDULE
 - A. Exposed sanitary traps: Insulation shall be the following:1. Cellular Glass: 1 inches thick on top of heat tracing
 - B. Domestic Water Piping: Insulation shall be the following:1. Cellular Glass: 1 inches thick on top of heat tracing.
- 3.18 UNDERGROUND <u>AND ABOVE GROUND GREASE WASTE</u> PIPING INSULATION SCHEDULE
 - A. Underground <u>and above gound grease waste</u>: Insulation shall be the following:
 1. Cellular Glass: 1.5 inches thick on top of heat tracing
- 3.19 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. Equipment, Concealed: None.
 - D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 1. Aluminum, Stucco Embossed: 0.016 inch thick.
 - E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. None.
 - 2. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations 0.040 inch thick.
 - F. Piping, Concealed: None.
 - G. Piping, Exposed:1. Aluminum Stucco Embossed: 0.016 inch thick.

3.20 OUTDOOR AND UNDERGROUND, 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. Equipment, Concealed: None.

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- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.020 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations 0.032 inch thick.
- F. Piping, Concealed: None.
- G. Piping, Exposed:1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam 0.020 inch thick.

END OF SECTION 22 0700

SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.
 - B. Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation are included by reference for information only.
 - C. Division 01 Section 01 81 13 Sustainable Design Requirements LEED v4 BD+C for additional LEED v4 requirements related to commissioning.
 - D. ASHRAE standard 90.1-2010 and ASHRAE Guideline 0-2013 (The Commissioning Process) and ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.

1.2 SUMMARY

- A. This section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section 01 91 13 "General Commissioning Requirements" for general commissioning process requirements.
- 1.3 DESCRIPTION
 - A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for the description of commissioning.
- 1.4 DEFINITIONS
 - A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for definitions.
- 1.5 SUBMITTALS
 - A. Refer to Division 01 Section "General Commissioning Requirements" for CxA's role.
 - B. Refer to Division 01 Section "Submittal Procedures" for specific requirements. In addition, provide the following:
 - 1. Certificates of readiness
 - 2. Certificates of completion of installation, prestart, and startup activities.
 - 3. O&M manuals
 - 4. Test reports
- 1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractor will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

- 2.1 TEST EQUIPMENT
 - A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the contractor for the equipment being tested. For example, the plumbing contractor of Division 22 shall ultimately be responsible for all standard testing equipment for the plumbing system in Division 22, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by each subcontractor.
 - B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
 - C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
 - D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or 0.1°F. Pressure sensors shall have an accuracy of + or 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

- 3.1 GENERAL DOCUMENTATION REQUIREMENTS
 - A. With assistance from the installing contractors, the CxA will prepare Verification Checklists for all commissioned components, equipment, and systems, the contractor shall execute the VC.

B. Red-lined Drawings:

- 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
- 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
- 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
- 4. The contracted party, as defined in the Contract Documents will create the asbuilt drawings.
- C. Operation and Maintenance Data:
 - 1. CM at Risk and the subcontractor will provide a copy of O&M literature within 45 days of each submittal acceptance to the CxA for use during the commissioning process for all commissioned equipment and systems.
 - 2. The CxA will review the O&M literature once for conformance to project requirements.
 - 3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the CM at Risk and the Subcontractor.
- D. Demonstration and Training:
 - 1. CM at Risk and the Subcontractor will provide demonstration and training as required by the specifications.
 - 2. A complete training plan and schedule must be submitted by the CM at Risk and the subcontractor to the CxA a minimum of four (4) weeks prior to any training.
 - 3. A training agenda for each training session must be submitted by the CM at Risk and the Subcontractor to the CxA, the A/E, and the OR a minimum of one (1) week prior the training session.
 - 4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, the A/E and the OR.
 - 5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
 - 6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
 - 7. Review data in O&M Manuals.
- E. Systems Manual requirements:
 - 1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
 - 2. The CM at Risk shall include final approved versions of the following information for the Systems Manual:
 - a. As-Built System Schematics
 - b. Verified Record Drawings
 - c. Test Results (not otherwise included in Cx Record)
 - d. Periodic Maintenance Information for computer maintenance management system
 - e. Recommendations for recalibration frequency of sensors and actuators

- f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
- g. Training Records, Information on training provided, attendees list, and any on-going training
- 3. This information shall be organized and arranged by building system, such as DW hot water, etc.
- 4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.
- 3.2 CM at RISK AND SUBCONTRACTOR'S RESPONSIBILITIES
 - A. Perform commissioning tests at the direction of the CxA.
 - B. Attend automatic controls coordination meetings.
 - C. Attend construction review and coordination meetings.
 - D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
 - E. Provide information requested by the CxA for final commissioning documentation.
 - F. Include requirements for submittal data, operation and maintenance data, and training in each submission.
 - G. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to the CM at Risk and the CxA.
 - H. Update schedule as required throughout the construction period.
 - I. During the startup and initial checkout process, execute the related portions of the verification checklists for all commissioned equipment.
 - J. Assist the CxA with all verification and functional performance tests.
 - K. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
 - L. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to A/E for approval (45) days after submittal acceptance. A/E shall issue the O & M manuals to the CxA for review of design compliance.
 - M. Coordinate with the CxA to provide (48) hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

- N. Notify the CxA and the A/E a minimum of (2) weeks in advance of the time for start of the balancing work. Attend the initial balancing meeting for review of the balancing procedures.
- O. Participate in, and schedule vendors and contractors to participate in the training sessions.
- P. Provide written notification to the CxA and the A/E that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
 - 1. Plumbing equipment including domestic water heaters, pumps, and all other equipment furnished under Division 22.
 - 2. Domestic hot water (DHW) distribution system, sanitary waste and vent piping, storm drainage piping, and sump pumps.
 - 3. Fire stopping in fire rated construction, including caulking, gasketing and sealing of smoke barriers.
- Q. The equipment supplier shall document the performance of his equipment.
- R. Provide a complete set of red-lined drawings to the CxA & A/E prior to the start of Functional Performance Testing.
- S. Balance Contractor
 - 1. Attend initial commissioning coordination meeting scheduled by the CxA.
 - 2. Submit the site specific balancing plan to the CxA and A/ E for review and acceptance.
 - 3. Attend the balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in balancing the Plumbing system.
 - 4. At the completion of the balancing work, and the submittal of the final balancing report, notify the Plumbing contractor and the CM at Risk.
 - 5. At the completion of balancing work, and the submittal of the final balancing report, notify the Plumbing Contractor and the CM at Risk.
 - 6. Participate in verification of the balancing report, which will consist of repeating measurements contained in the balancing reports. Assist in diagnostic purposes when directed.
- T. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- U. Equipment Suppliers
 - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
 - 2. Assist in equipment testing per agreements with contractors.
 - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- V. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for additional contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Design Professional's Responsibilities.

3.5 CxA's RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for CxA's Responsibilities.

3.6 TESTING PREPARATION

- A. Certify in writing to the CM at Risk, the CxA and the A/E that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CM at Risk, the CxA and the A/E that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 DOMESTIC WATER BALANCING VERIFICATION

- A. Prior to performance of domestic hot water (DHW) Water Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CM at Risk and the CxA.
- B. Notify the CM at Risk and the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness balancing Work.

- C. Provide technicians, instrumentation, and tools to verify testing and balancing of Plumbing systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification.
 - 2. The balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final balancing report.
 - 4. Remedy the deficiency and notify the CM at Risk and the CxA so verification of failed portions can be performed.

3.8 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Plumbing testing shall include entire Plumbing installation. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CM at Risk and the CxA along with the Plumbing contractor, TAB contractor and Controls contractor shall prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- 3.9 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 22 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. Plumbing Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 22 and Division 23 Sections. Assist the CM at Risk and the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 22 piping Sections. Plumbing Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CM at Risk and the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of natural gas, sanitary waste and vent piping, storm drainage piping, sprinkler and domestic water distribution systems.
- E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation.
- F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
 - 1. Domestic Hot Water System(s)
 - 2. Domestic Water Pumps
 - 3. Fuel oil system
 - 4. Compressed air system
 - 5. Lift Station
 - 6. Sump pumps
- G. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.
- 3.10 APPROVAL

A. Refer to Division 01 Section "General Commissioning Requirements" for approval procedures.

3.11 DEFERRED TESTING

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deferred testing.

3.12 OPERATION AND MAINTENANCE MANUALS

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.
- B. Refer to Division 01 Section "General Commissioning Requirements" for the AE and the CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.13 TRAINING OF OWNER PERSONNEL

- A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to training. All training shall be videotaped for future use.
- B. Plumbing Contractor. Shall have the following training responsibilities:
 - 1. Provide the CM at Risk with a training plan for review by the CxA, the A/E and the OR a minimum of two weeks before the planned training.
 - 2. Provide designated OR with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of Plumbing equipment. A certified factory manufactures representative shall be present for training of Owner personnel.
 - 3. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 4. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise, as well as in-depth knowledge of all modes of operation of the specific piece of equipment, is required. More than one party may be required to execute the training.
 - 5. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 6. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
 - 7. The plumbing contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls.
 - 8. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.

END OF SECTION 22 08 00

SECTION 22 11 16 - 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. This section includes water distribution piping and related components inside the building for the domestic water piping system to 5 feet outside the building.
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Transition fittings.
 - 5. Dielectric fittings.
 - 6. Flexible connectors.
 - 7. Water meters furnished by utility company for installation by Contractor.
 - 8. Water meters.
 - 9. Escutcheons.
 - 10. Sleeves and sleeve seals.
 - 11. Wall penetration systems.
- B. Related Section:
 - 1. Division 22 Section 22_05_23 "General Duty Valves for Plumbing Piping."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements – LEED V4 BD+C".
 - 1. Product Data: Documentation for Leadership Extraction Practices in the following:
 - a. Leadership Extraction Practices for Recycled Content
 - 2. Product Data: Documentation for Low Emitting Materials
 - a. Low Emitting Materials for Adhesives and Sealants

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- Product Certificates: Provide the following:
 a. Environmental Product Declarations (EPD's)
- C. Water Samples: Specified in "Cleaning" Article.
- D. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.
 - 4. HVAC ductwork.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.
- C. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be manufacturer designed and supplied by the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability
 - 2. Inspection Requirement for Grooved Piping Systems:
 - a. A manufacturer's factory trained representative (a direct employee of the manufacturer) shall periodically visit the job site and review the installation for best practices. This shall be at the expense of the installing contractor. The installing Contractor shall correct any identified deficiencies
 - b. Product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and reexamined by Inspection Services prior to the completion of the project. Any product that has not been corrected or was not examined will not be considered as part of the successful completion of Inspection Services. Any products that require a torque per written manufacturer's installation instructions shall be verified as

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torqued with a properly-certified torque wrench

c. At the completion of system inspection, a report shall be provided to the project team and a long-term installation warranty may be provided to the Owner covering inspected joints

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owners Authorized Representative (OAR) no fewer than five days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without OAR written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- 2.2 COPPER TUBE AND FITTINGS
 - A. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type B) water tube, drawn temper.
 - 1. Copper Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.

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- 3) Viega; Plumbing and Heating Systems. (Propress)
- 2. Above ground only.
- 3. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 4. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 2. Product Data: Documentation for Leadership Extraction Practices in the following:
- 1. Leadership Extraction Practices for Recycled Content. Recycled Content value shall total no less than 35% post + ½ pre-consumer content of the material.
- 2. Provide material cost data for all copper pipe.
- 3. Grooved-Joint Copper Tube Appurtenances:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Victaulic
 - 2) Owner-approved Substitution
- 2. Aboveground only
- 3. NPS 2 to NPS 8: Fittings ASTM B 75 copper tube or ASTM B 152 wrought copper fittings with copper tubing sized grooved ends
- 4. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections cast with offsetting, angle-pattern bolt pads to provide system rigidity upon visual metal-to-metal bolt pad contact with no torque requirement, coated with copper-colored enamel, Grade EHP EPDM-synthetic rubber gasket UL classified in accordance with ANSI/NSF61 for hot (180F) and cold (86F) water, and bolts and nuts. Victaulic Style 607 or Owner approved Substitution.
- B. C. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems. (Propress)
 - 2. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

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3. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content. Recycled Content value shall total no less than 35% post + $\frac{1}{2}$ pre-consumer content of the material.
 - 2. Provide material cost data for all ductile iron pipe.
- B. Mechanical-Joint, Thickness Class 54, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - 1. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - 1. Gaskets: AWWA C111, rubber.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Victaulic Company.
 - 2) Owner approved substitution.
 - 2. Grooved-End, Ductile-Iron Fittings: ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - 3. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

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2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Encasement for Underground Metal Piping:
 - 1. Standards: ASTM A 674 or AWWA C105.
 - 2. Form: Sheet or tube.
 - 3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
 - 4. Color: Natural.

2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section 22_05_23 "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.

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B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - 1. Pressure Rating: 150 psig at 180 deg F.
 - 2. End Connections: Compatible with pipes to be joined.
 - 2. Shall be listed under ASSE Standard No. 1079.
- C. Dielectric Flanges:
 - 1. Description:
 - 1. Factory-fabricated, bolted, companion-flange assembly.
 - 2. Pressure Rating: 150 psig minimum.
 - 3. End Connections: Compatible with pipes to be joined.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig.
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - 1. Galvanized-steel coupling.
 - 2. Pressure Rating: 300 psig at 225 deg F.
 - 3. End Connections: Female threaded.
 - 4. Lining: Inert and noncorrosive, thermoplastic.

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- F. Dielectric Nipples:
 - 1. Description:
 - 1. Electroplated steel nipple complying with ASTM F 1545.
 - 2. Pressure Rating: 300 psig at 225 deg F.
 - 3. End Connections: Male threaded or grooved.
 - 4. Lining: Inert and noncorrosive, propylene.
 - 5. Unlined copper-silicone casting alternative.

2.9 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.
 - 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.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

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H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinccoated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.12 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe 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.

2.13 WALL PENETRATION SYSTEMS

- A. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.

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- 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
- 3. Housing-to-Sleeve Gasket: EPDM rubber.
- 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
- 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53, Schedule 40, zinccoated steel pipe.
- B. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content. Recycled Content value shall total no less than 10% post + ½ pre-consumer content of the material. See concrete section 03 30 00 <u>"Cast-In-Place Concrete"</u> for additional information.

GROUT

- C. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- D. Characteristics: Nonshrink; recommended for interior and exterior applications.
- E. Design Mix: 5000-psi, 28-day compressive strength.
- F. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section <u>31 20 00</u> "Earth Moving<u>for Building</u> <u>Slabs</u>" for excavating, trenching, and backfilling

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.

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- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section 22_05_19 "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install unions or grooved-joint couplings in copper tubing at final connection to each piece of equipment, machine, and specialty.

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- S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section 22_05_19 "Meters and Gages for Plumbing Piping" for pressure gages.
- T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section 22_11_23 "Domestic Water Pumps" for thermostats.
- U. Install thermometers on outlet piping from each tank type water heater. Comply with requirements in Division 22 Section 22_05_19 "Meters and Gages for Plumbing Piping" for thermometers.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel or groove 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. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- E. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- F. 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.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- H. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The

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gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be developed and supplied by the system manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section 22_05_23 "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section 22_11_19 "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for calibrated balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plasticto-metal transition fittings or unions.

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3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 WATER METER INSTALLATION

- A. Rough-in domestic water piping, and install water meters according to utility company's requirements.
- B. Install water meters according to AWWA M6, utility company's requirements, and the following:
- C. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- D. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- E. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

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- 1. Vertical Piping: MSS Type 8 or 42, clamps.
- 2. Individual, Straight, Horizontal Piping Runs:
- 1. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- 2. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 5 feet with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 6 feet with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 8 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 9 feet with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 7 feet with 3/8-inch rod.
 - 2. NPS 1-1/2: 9 feet 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.
- G. Install supports for vertical steel piping every 15 feet.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

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3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons on exposed piping for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.

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- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - 1. Extend sleeves 2 inches above finished floor level.
 - 2. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Use Fire Barrier water tight sealants by 3M where sleeves do not fit inside the wall.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - 1. PVC pipe sleeves for pipes smaller than NPS 6.
 - 2. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - 3. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs Steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:

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- 1. Steel pipe sleeves for pipes smaller than NPS 6.
- 2. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
- 3. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- 4. Do not use sleeves when wall penetration systems are used.
- 6. Sleeves for Piping Passing through Interior Concrete Walls:
- 1. Steel pipe sleeves for pipes smaller than NPS 6.
- 2. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. 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 in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

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3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures or applying pipe insulation.
 - 2. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 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.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

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3.16 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. 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.

3.17 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:
 - 1. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - 2. 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.
 - 3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - 4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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- 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
- 1. Flush piping system with clean, potable water until dirty water does not appear at outlets.
- 2. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- 3.18 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, grooved-joint couplings and unions may be used for aboveground piping joints unless otherwise indicated.
 - C. Underground, domestic water, building service piping, NPS 4 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K wrought-copper solder-joint fittings; and brazed joints.
 - D. Underground, domestic water, building-service piping, NPS 4 to NPS 8, shall be one of the following:
 - 1. Push-on-joint, ductile-iron pipe; standard pattern push-on-joint fittings; and gasketed joints.
 - 2. SCH-80 PVC, may be used in non-traffic areas outside of the building perimeter only, socket fittings; and solvent-cemented joints.
 - E. Underground, 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 joints.
 - F. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type K, copper pressure-seal-joint fittings; and pressure-sealed joints.

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- 2. Hard copper tube, ASTM B 88, Type K, grooved joints (down to 2").
- G. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type K; cast or wrought copper solder-joint fittings; and brazed joints.
 - 2. Hard copper tube, ASTM B 88, Type K; grooved-joint copper-tube appurtenances; and grooved joints.
- 3.19 VALVE SCHEDULE
 - A. General:
 - 1. Shutoff: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged or grooved ends for piping NPS 2-1/2 and larger.
 - 2. Throttling: 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: Calibrated balancing valves or automatic balancing valves.
 - 4. Drain: Hose-end drain valves.
 - B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
 - C. Iron or brass grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 1116

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Post hydrants.
 - 10. Drain valves.
 - 11. Water hammer arresters.
 - 12. Air vents.
 - 13. Trap-seal primer valves.
 - 14. Trap-seal primer systems.
- B. Related Sections include the following:
 - 1. Division 22 Section 22 0519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section 22 11 16 "Domestic Water Piping" for water meters.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

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1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components Health Effects; Sections 1 through 9."
- C. ASSE Compliance: All products shall be listed under the specific ASSE standard.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.

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- 6. Finish: Chrome plated.
- 7. Equal to Watts No. 288A.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.
 - 6. Equal to Watts No. NF8 or No. 8A.
 - 7. Standard: ASSE 1020.
 - 8. Operation: Continuous-pressure applications.
 - 9. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 - 10. Size: As scheduled or shown.
 - 11. Design Flow Rate: As scheduled or shown.
 - 12. Selected Unit Flow Range Limits: As scheduled or shown.
 - 13. Pressure Loss at Design Flow Rate: As scheduled or shown.
 - 14. Accessories: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wilkins Division/Zurn 30
 - b. Watts Regulator Co. 288A
 - c. Febco Division/CBM 710 or 715
 - 2. Standard: ASSE 1012.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: As scheduled or shown.
 - 5. Body: Bronze.
 - 6. End Connections: Union, solder joint.
 - 7. Finish: Rough bronze.
 - 8. Atmospheric vacuum breaker shall be constructed of bronze body with plastic poppet float action as a check valve. The opening to atmosphere at a minimum pressure of 1 psig. All internal parts shall be corrosion resistant and shall be

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removable or replaceable without removing the unit from the line. The unit shall be suitable for temperatures up to 210 degrees F.

- B. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
 - c. Owner approved substitution.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 - 5. Size: As scheduled or shown.
 - 6. Design Flow Rate: As scheduled or shown.
 - 7. Selected Unit Flow Range Limits: As scheduled or shown.
 - 8. Pressure Loss at Design Flow Rate: As scheduled or shown.
 - 9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 11. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - 12. The reduced pressure backflow preventer shall be a complete assembly consisting of two independently acting spring-loaded toggle lever check valves, an automatic pressure differential relief valve located between the two check valves, two shut-off valves and four test cocks. The operation shall be completely automatic. All internal parts of the toggle lever check valves and pressure differential relief valve shall be removable and replaceable without removing the backflow preventer assembly from the line.
- C. Double-Check Backflow-Prevention Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide Watts Regulator Co. LF719 for ³/₄ to 2 inch and Watts Regulator Co. LF 709 for 2-1/2 to 10 inches, or approved products by one of the following:
 - a. Wilkins Division/Zurn.
 - b. Hersey Products, Inc.

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- 2. Standard: ASSE 1015.
- 3. Operation: Continuous-pressure applications, unless otherwise indicated.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Size: As scheduled or shown.
- 6. Design Flow Rate: As scheduled or shown.
- 7. Selected Unit Flow Range Limits: As scheduled or shown.
- 8. Pressure Loss at Design Flow Rate: As scheduled or shown.
- 9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
- 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 11. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- 12. The double check valve assembly shall be constructed of corrosion resisting materials. It shall consist of two independently acting spring-loaded poppet check valves, two isolation valves and four test cocks. All internal parts shall be accessible without removing the valves from the line.
- D. Dual-Check-Valve Backflow Preventers:
 - 1. Subject to compliance with requirements, provide Watts SD-3 or products by one of the following:
 - a. Mueller Co.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: See drawings.
 - 5. Body: Bronze with union inlet.
- E. Hose-Connection Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - 2. Standard: ASSE 1052.
 - 3. Operation: Up to 10-foot head of water back pressure.

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- 4. Inlet Size: NPS 1/2 or NPS 3/4.
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm flow.
- F. Backflow-Preventer Test Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

- A. Water Pressure Regulators:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McDonnel & Miller
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Spirax Sarco
 - 2. Standard: ASSE 1003.
 - 3. Pressure Rating: Initial working pressure of 150 psig.
 - 4. Size: As scheduled or shown.
 - 5. Design Flow Rate: As scheduled or shown.
 - 6. Design Inlet Pressure: As scheduled or shown.
 - 7. Design Outlet Pressure Setting: As scheduled or shown.
 - 8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
 - 9. Pressure reducing valves shall have a means of externally adjusting the outlet pressure. All internal parts subject to ware shall be replaceable without removing the valve from the piping. Valves shall have an integral low inlet pressure check valve, and shall maintain outlet pressure with varying flow and inlet pressure.
 - 10. 2-1/2 Inch and Smaller: Valves shall be diaphragm actuated, self-contained, single seated, direct acting, spring loaded, with bronze body and stainless steel trim.
 - 11. 3 Inch and Larger: Valves shall be external pilot operated, cast iron body, stainless steel trim, with bronze diaphragm and composition disc.
 - 12. Valves for Booster Heater Water Supply: Include integral bypass.
 - 13. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

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14. Valves shall be capable of reducing a varying inlet pressure to a constant-flowing outlet pressure with pressures, as noted, equal to Watts No. 223 and No. SC-N223.

2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Hammond Valve.
 - c. Red-White Valve Corp.
 - 2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
 - 3. Body: Brass or bronze.
 - 4. Size: Same as connected piping, but not larger than NPS 2.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Hammond Valve.
 - c. Red-White Valve Corp.
 - 2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memorysetting indicator.
 - 3. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. NIBCO INC.

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- c. Red-White Valve Corp.
- 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
- 3. Pressure Rating: 400-psig minimum CWP.
- 4. Size: NPS 2 or smaller.
- 5. Body: Copper alloy.
- 6. Port: Standard or full port.
- 7. Ball: Chrome-plated brass.
- 8. Seats and Seals: Replaceable.
- 9. End Connections: Solder joint or threaded.
- 10. Handle: Vinyl-covered steel with memory-setting device.
- E. Automatic Balancing Valves for Hot Water Recirculation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic
 - b. Owner-approved Substitution
 - 2. Standard: Certified in accordance with ANSI/NSF 61 and 372
 - 3. Pressure Rating: 400 psig CWP suitable for working pressures with differential control ranges of 2-32 psi or 5-60 psi.
 - 4. Sizes: $\frac{1}{2}$ and $\frac{3}{4}$ "
 - 5. Body: 300 Series stainless steel
 - 6. Accuracy: +/- 5% over 95% of the control range

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.
 - c. Watts Industries, Inc.; Water Products Div.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Union inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Tempered-Water Setting: As scheduled or shown.

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- 9. Tempered-Water Design Flow Rate: As scheduled or shown.
- 10. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Exposed-mounting or Cabinet-type as scheduled or shown, thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Union inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 9. Tempered-Water Setting: As scheduled or shown.
 - 10. Tempered-Water Design Flow Rate: As scheduled or shown.
 - 11. Selected Valve Flow Rate at 45-psig Pressure Drop: As scheduled or shown.
 - 12. Pressure Drop at Design Flow Rate: As scheduled or shown.
 - 13. Valve Finish: Rough bronze.
 - 14. Piping Finish: Copper.
 - 15. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting as scheduled or shown and with hinged, stainless-steel door.
- C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - 2. Description: Factory-fabricated, cabinet-type or exposed-mounting as scheduled or shown, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement.
 - 3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 - 4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.

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- 5. Small-Flow Parallel: Thermostatic water mixing valve.
- 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
- 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
- 8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
- 9. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting as scheduled or shown and with hinged, stainless-steel door.
- 10. Selected Large Flow, Tempered Water Valve Size: As scheduled or shown.
- 11. Tempered-Water Setting: As scheduled or shown.
- 12. Unit Tempered-Water Design Flow Rate: As scheduled or shown.
- 13. Unit Minimum Tempered-Water Design Flow Rate: As scheduled or shown.
- 14. Selected Unit Flow Rate at 45-psig Pressure Drop: As scheduled or shown.
- 15. Unit Pressure Drop at Design Flow Rate: As scheduled or shown.
- 16. Unit Tempered-Water Outlet Size: As scheduled or shown...
- 17. Unit Hot- and Cold-Water Inlet Size: As scheduled or shown.
- 18. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
- 19. Piping Finish: Copper.
- D. Individual-Fixture, Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 - 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 4. Body: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Inlets and Outlet: Threaded.
 - 7. Finish: Rough or chrome-plated bronze.
 - 8. Tempered-Water Setting: As scheduled or shown.
 - 9. Tempered-Water Design Flow Rate: As scheduled or shown.
- E. Primary Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heat-Timer Corporation.
 - b. Holby Valve Co., Inc.

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- 2. Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
- 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 4. Body: Bronze.
- 5. Temperature Control: Manual.
- 6. Inlets and Outlet: Threaded.
- 7. Selected Primary Water Tempering Valve Size: As scheduled or shown.
- 8. Tempered-Water Setting: As scheduled or shown.
- 9. Tempered-Water Design Flow Rate: As scheduled or shown.
- 10. Pressure Drop at Design Flow Rate: As scheduled or shown.
- 11. Tempered-Water Outlet Size: As scheduled or shown.
- 12. Cold-Water Inlet Size: As scheduled or shown.
- 13. Hot-Water Inlet Size: As scheduled or shown.
- 14. Valve Finish: Rough bronze.

2.6 WATER FILTERS

- A. In-line cold water filter for up to 1.3 GPM capable of removing dirt/rust, odor and scale.
 - 1. Equal to Aqua-Pure No. AP717.
- B. On cold water lines for the following:
 - 1. Coffee makers.
 - 2. Electric water coolers.
 - 3. Refrigerators.
 - 4. Ice makers.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 - 1. Wye type shall be full line size of the connecting pipe. Flanged wye-type shall have bolted covers in 2-1/2 through 8 inches and hinged covers in 10 inch and larger. Threaded shall have threaded gasketed caps 2 inches and smaller with NPT blowdown outlet. Provide blowdown valve.
 - 2. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 and larger.
 - 4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 5. Screen: 304 stainless steel with round perforations, unless otherwise indicated.
 - 6. Perforation Size:

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- a. Strainers NPS 2 and Smaller: 0.020 inch.
- b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
- c. Strainers NPS 5 and Larger: 0.10 inch.
- 7. Bronze Body with Threaded Connections:

Manufacturer and Model:

		125 SWP/200 WOG	250 SWP/400 WOG
a.	Mueller Steam	351	352
b.	Spirax/Sarco	BT	ТВТ
C.	Armstrong	F4SC	A1S

8. Bronze Body with Solder Connection: Solder type wye strainers shall be class 250 SWP/400 WOG.

Manufacturer and Model:

- a. Mueller Steam Specialties 11-M
- b. Spirax/Sarco TBT
- c. O.C. Keckley Co. Style F
- 9. Cast Iron Body with Threaded Connection: Y-type strainers shall be class 250 SWP/300 WOG.

Manufacturer and Model:

- a. Mueller Steam Specialties 11-M
- b. Spirax/Sarco IT
- c. Armstrong Machine Co. A1SC
- 10. Cast Iron Body with Flanged Connections:

Manufacturer and Model:

	<u>12</u>	<u>25 SWP/200 WOG</u>	250 SWP/400 WOG
a.	Mueller Steam Specialties	751	752
b.	Spirax/Sarco	CI	AF
C.	Armstrong Machine Wor	rks A1FL-125	A1FL-250

11. Grooved Connection: Ductile iron body, minimum 300 psi working pressure.

Manufacturer and Model:

- a. Victaulic Style 732
- b. Owner approved substitution.

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- 12. Drain: Provide hose-end drain valve for 3/4 inch or smaller ports. Provide full size blow-down valve and hose-end drain valve if blow-down valve size is greater than 3/4 inch.
- 13. 2 Inch and Smaller: Equal to Sarco Type BT or Conbraco 59 Series.
- 14. 2-1/2 Inch and Larger: Equal to Sarco IF-125, or 250 psig wsp, equal to Sarco AF-250.
- 2.8 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 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig.
 - 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 8. Finish for Equipment Rooms HB-2: Rough bronze, or nickel plated.
 - 9. Finish for Service Areas HB-2: Rough bronze.
 - 10. Finish for Finished Rooms HB-1: Chrome or nickel plated.
 - 11. Operation for Equipment Rooms: 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 wall flange with each chrome- or nickel-plated hose bibb.
 - B. Hose bibb HB-3
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. No. U-25.
 - b. Potter Roemer Fire Pro.
 - s. Fire End & Crocker Corp.
 - 2. Material: Cast brass angle valve.
 - 3. Pressure Rating: 300 psig.
 - 4. Operation: Rising stem with hand wheel.
 - 5. Inlet: NPS 1 ¹/₂ female thread.
 - 6. Outlet: NPS 1 $\frac{1}{2}$ male hose thread.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Woodford Manufacturing Company.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig.
- 4. Operation: Loose key.
- 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 6. Inlet: NPS 3/4 or NPS 1.
- 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounting with cover.
- 9. Box and Cover Finish: Chrome plated.
- 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
- 12. Operating Keys(s): One with each wall hydrant.

2.10 POST HYDRANTS

- A. Nonfreeze, Sanitary-Type Post Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, provide J.R. Smith Model 5903 or one of the following:
 - a. Wade, Inc.
 - b. Watts Drainage Products Inc.
 - c. Woodford Manufacturing Company.
 - 2. Standard: ASME A112.21.3M.
 - 3. Type: Nonfreeze, exposed-outlet post hydrant.
 - 4. Operation: Lock wheel.
 - 5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 - 6. Casing: Bronze with casing guard.
 - 7. Inlet: NPS 3/4.
 - 8. Outlet: Garden-hose thread complying with ASME B1.20.7.
 - 9. Drain: Self-contained by draining into the sealed canister.
 - 10. Vacuum Breaker: Nonremovable, drainable, hose-connection; and garden-hose thread complying with ASME B1.20.7 on outlet.
 - 11. Operating Key(s): One with each loose-key-operation wall hydrant.

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2.11 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.
 - 10. Equal to NIBCO Inc. T-585-70-66-HC (threaded); NIBCO Inc. S-585-70-66-HC (solder) non-removable vacuum breaker, equal to Watts No. 8A.

2.12 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - 2. Standard: ASSE 1010 or PDI-WH 201.
 - 3. Type: Metal bellows or Copper tube with piston.
 - 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
 - 5. Equal to Smith Series No. 5000.
 - 6. Provide 12-inch by 12-inch access panels for each arrester located in inaccessible location.

2.13 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
 - 1. Body: Bronze.
 - 2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
 - 3. Float: Replaceable, corrosion-resistant metal.
 - 4. Mechanism and Seat: Stainless steel.
 - 5. Size: NPS 3/8 minimum inlet.

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- 6. Inlet and Vent Outlet End Connections: Threaded.
- 7. 3/4 Inch, cast brass construction, 150 psig wwp, equal to Hoffman Specialty No. 78.
- B. Welded-Construction Automatic Air Vents:
 - 1. Body: Stainless steel.
 - 2. Pressure Rating: 150-psig minimum pressure rating.
 - 3. Float: Replaceable, corrosion-resistant metal.
 - 4. Mechanism and Seat: Stainless steel.
 - 5. Size: NPS 3/8 minimum inlet.
 - 6. Inlet and Vent Outlet End Connections: Threaded.
- 2.14 TRAP-SEAL PRIMER VALVES
 - A. Supply-Type, Trap-Seal Primer Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - 2. Standard: ASSE 1018.
 - 3. Pressure Rating: 125 psig minimum.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 - 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 - 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
 - B. Drainage-Type, Trap-Seal Primer Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Owner approved substitution.
 - 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 - 3. Size: NPS 1-1/4 minimum.
 - 4. Material: Chrome-plated, cast brass.

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2.15 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
 - b. Owner approved substitution.
 - 2. Standard: ASSE 1044,
 - 3. Piping: NPS 3/4, ASTM B 88, Type K; copper, water tubing.
 - 4. Cabinet: Recessed or Surface mounting steel box as scheduled or shown, with stainless-steel cover.
 - 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 6. Vacuum Breaker: ASSE 1001.
 - 7. Number Outlets: As scheduled or shown.
 - 8. Size Outlets: NPS 1/2.

2.16 AQUASTATS

- A. Immersed type adjustable volatile liquid mercury tube switch equal to Mercoid Type DA-37-2 Range 5 (1 pole single), equal to Mercoid Type DA-37-127 Range 5 (2 pole duplex).
- B. Manufacturers:
 - 1. Paragon Electric Co.
 - 2. Tork Clock Co.
 - 3. General Electric Co.
 - 4. Sangamo Electric Co.
 - 5. General Controls Co.

2.17 METAL PEDESTAL PET FOUNTAINS WS-1

- A. Designed to withstand the rough conditions with steel support plate, spout locked to stainless steel receptor and protected with vandal resistant steel guard. Additional lower drinking spigot, self-closing hose bibb and attached hose and hanger.
 - 1. Manufacturers: Subject to compliance with requirements, provide Stern Williams No. 9100-66-SS or approved products by one of the following:
 - a. MDF, Inc
 - b. Terra Bound Solutions, Inc.

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- 2. Body: Stainless steel.
- 3. Receptor: slow draining pet fountain receptor with pebble guard drain
- 4. Operation: Recessed self-closing push button valve with outside stream adjustment.
- 5. Hose: 5-ft rubber.
- 6. Finish: Stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressurereducing valve, solenoid valve, and pump.

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- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install 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 air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- L. 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.
- M. 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.
- N. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- O. Set aquastats in oversized tee and nipple in hot water return line for automatically controlling hot water circulators and hot water circulating pumps.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section <u>26 05 26</u> "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and CablesBusway – Low voltage."

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. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.

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- 3. Double-check backflow-prevention assemblies.
- 4. Dual-check-valve backflow preventers.
- 5. Water pressure-reducing valves.
- 6. Calibrated balancing valves.
- 7. Primary, thermostatic, water mixing valves.
- 8. Manifold, thermostatic, water-mixing-valve assemblies.
- 9. Primary water tempering valves.
- 10. Supply-type, trap-seal primer valves.
- 11. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

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SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:
 - 1. Close-coupled, horizontally mounted, in-line centrifugal pumps.
 - 2. Close-coupled, vertically mounted, in-line centrifugal pumps.
 - 3. Pump Controls where self-contained.
- B. Related Sections include the following:
 - 1. Division 22 Section 22 11 23.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Line diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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- 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- D. The pump manufacturer supplying the equipment listed under this article shall provide a written guarantee covering all the equipment as well as the system performance for one year from date of shipment. The system shall not produce objectionable noise, vibration or fluctuations of system pressure when performing under head and capacity as specified.
- E. When minimum energy ratings or efficiencies are specified the pump manufacturer shall provide the equipment of the equivalent efficiencies and energy ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

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- 1. Armstrong Pumps Inc.
- 2. Bell & Gossett Domestic Pump; ITT Industries.
- 3. Aurora.
- B. Description: Factory-assembled and -tested, overhung impeller, single-stage, closecoupled, horizontally mounted, in-line centrifugal pumps as defined in ANSI/HI 1.1-1.2 and ANSI/HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
 - 1. Pump Construction: All bronze or bronze fitted.
 - a. Casing: Radially split, cast iron, with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
 - c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 - d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Bearings: Oil-lubricated; bronze-journal or ball type.
 - 2. Shaft Coupling: Rigid type if pump is provided with coupling.
 - 3. Motor: Single speed, with grease-lubricated ball bearings. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
- C. Capacities and Characteristics:
 - 1. See pump schedule on drawings.

2.3 CLOSE-COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Aurora Pump.
 - 2. Bell & Gossett Domestic Pump; ITT Industries.
 - 3. Armstrong Pumps Inc.
- B. Description: Factory-assembled and -tested, overhung impeller, single-stage, closecoupled, vertically mounted, in-line centrifugal pumps as defined in ANSI/HI 1.1-1.2 and ANSI/HI 1.3; and designed for installation with pump and motor shafts mounted vertically.
 - 1. Pump Construction: Bronze fitted.

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- a. Casing: Radially split, cast iron, with wear rings and threaded companionflange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections. Include pump manufacturer's base attachment for mounting pump on concrete base.
- b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
- c. Shaft and Shaft Sleeve: Stainless-steel shaft, with copper-alloy shaft sleeve.
- d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
- e. Bearings: Oil-lubricated; bronze-journal or ball type.
- 2. Shaft Coupling: Rigid type if pump is provided with coupling.
- 3. Motor: Single speed, with grease-lubricated ball bearings; and directly mounted to pump casing. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - a. Lifting and Supporting Lug: Factory mounted in top of motor enclosure.
- C. Capacities and Characteristics:
 - 1. See pump schedule on drawings.
- 2.4 CONTROLS
 - A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Mercoid.
 - c. Square D.
 - d. White-Rodgers Div.; Emerson Electric Co.
 - 2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
 - 3. Range: 65 to 200 deg F.
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: As required.
 - 7. Settings: Start pump at 105 deg F and stop pump at 120 deg F.
 - 8. Equal to Mercoid Type DA-37-2 Range 5 (single pole), Mercoid Type DA-37-127 Ranges (2 pole).
 - B. Timers: Not required. Control shall be through the Division 23 Building Management System.

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2.5 FLEXIBLE CONNECTORS

- A. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig minimum working-pressure rating and ends matching pump connections.
 - 1. Equal to M.I.I. Types BSS and BB.

2.6 BUILDING-AUTOMATION-SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
 - 1. On-off status of each pump.
 - 2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 22 Section "Common Work Results for Plumbing."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

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3.3 PUMP INSTALLATION

- A. As per structural drawings.
- B. Comply with ANSI/HI 1.4.
- C. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- E. Install in-line, sealless; separately coupled, in-line; separately coupled, horizontally mounted, in-line; and close-coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.
- F. Install continuous-thread hanger rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stop as scheduled of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section 22 O5 29 "Hangers and Supports for Plumbing Piping and Equipment."
- G. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stop as scheduled of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section 22_05_29 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Hanger and support materials are specified in Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment."
- H. Install vertical in-line pumps on concrete bases. Install pumps with motor and pump shafts vertical.
- 3.4 CONTROL INSTALLATION
 - A. Install immersion-type aquastats in hot-water return piping.
- 3.5 CONNECTIONS
 - A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to pumps to allow service and maintenance.

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- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Separately coupled, in-line centrifugal pumps.
 - b. Separately coupled, horizontally mounted, in-line centrifugal pumps.
 - c. Close-coupled, horizontally mounted, in-line centrifugal pumps.
 - d. Close-coupled, vertically mounted, in-line centrifugal pumps.
 - 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section 22_05_23 "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for strainers.
 - Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section 22_05_19 "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding" for Electrical Systems."
- E. Connect wiring according to Division 26 Section "<u>Busway -</u> Low-Voltage<u>" Electrical</u> Power Conductors and Cables."
- F. Connect aquastats to pumps that they control.
- G. Interlock pump with water heater burner and time delay relay.

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. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set aquastats for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.

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- b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
- c. Verify that pump is rotating in the correct direction.
- 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 7. Start motor.
- 8. Open discharge valve slowly.
- 9. Adjust temperature settings on thermostats.
- 10. Adjust timer settings.
- 3.7 DEMONSTRATION
 - A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1123

SECTION 22 11 23.13 - DOMESTIC WATER PACKAGED BOOSTER 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. Water booster pumps.
 - 2. Pump Controls where self-contained.
- B. Related Requirements: See drawings for further conditions, requirements and schedules.

1.3 SUBMITTALS

A. See Division 01 for submittal requirements.

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. Statically and dynamically balance rotating parts.
 - B. Pumps to operate at 3450 rpm maximum unless specified otherwise.
 - C. Pump package shall be factory tested and pre-set to site conditions as well as hydrostatically tested. The testing laboratory shall be an NSF 61 Certified closed loop testing system capable of pressurized suction and supply pressure condition simulation. The test laboratory shall feature procedures detailing an <u>unbroken chain of calibrations</u> as required by NIST. Open atmospheric testing equipment or devices are not compliant. The specified flow conditions shall be tested and verified as well as specified supply pressure per plans and specifications. The factory to provide a factory certified performance test indicating pressure and flow from zero to 100% capacity. Certified "NSF/ANSI 61" documentation shall be submitted to the specifying engineer.
 - D. The manufacturer shall provide certificate indicating that they have passed compliance with NSF61 Drinking Water Systems based on Federal Legislation S.3874. This certification must be conducted by an approved 3rd Party Laboratory certified to NSF 61 Compliance Testing.
 - E. System must comply with ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings, Except Low-Rise Residential Buildings. This standard, which affects all projects after October 2013 requires

the use of a remote sensor at the top of the system or software which simulates the effect of a remote sensor in order to recover friction losses.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.Retain subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.
- B. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified and the booster pump will be fully operational after the seismic event."

2.3 DOMESTIC WATER BOOSTER PUMP - END SUCTION

- A. Provide a unitary pre-packaged domestic Water Pressure Booster Pumping System per engineering data flow, and head requirements. The entire system shall be listed under UL QCZJ, Packaged Pumping System requirements. System design is based on QuantumFlo, Inc.
- B. Pumps shall be, stainless steel, vertically mounted, close coupled, stainless steel fitted, end suction, centrifugal, pumps, with carbon/ceramic mechanical seals.
 - 1. Approved Manufacturers:
 - a. QuantumFlo, Inc.
 - b. Aurora/Pentair Pump Group
 - c. ITT/Bell & Gossett, Div.
 - 2. Motors shall be; 3450 RPM, High Efficiency, Class F insulated, electric motors designed for inverter duty application. The motors shall be suitable for the voltage, frequency, phasing and enclosure as indicated in the pump schedule on the project plan set.
 - a. Pumps and Motors: Refer to plumbing drawings for additional information.
- C. Structural Elements: The entire system shall be factory skid mounted on a minimum; 304 stainless-steel structural square tube support frame, with in-shear molded rubber vibration isolators. Horizontal systems shall feature a rack-style servicing system which will allow the user access to the pump and motor while the pump can remains on the system skid. (see plans for details)
- D. Valves: All valves shall be full port bronze ball valves, with S.S. ball and stem design for valve sizes 2 1/2" and smaller, and cast iron, epoxy coated lever operated, grooved end type butterfly valves, with stainless steel disc, and Stainless Steel shaft, for valve sizes 3" and larger. Valves must be rated for maximum pressure service for the system and also comply with NSF 61 Drinking Water requirements.
- E. Control Panel: The pumping system control panel shall incorporate the following elements, and criteria:

- The pump controller, and all its components shall be housed in a NEMA 3R, UL listed, ventilated control enclosure. The controller shall have a main power disconnect switch, with enclosure door interlock, which shall require opening the disconnect switch before the control cabinet may be opened. The system shall provide for a single point electrical connection, with all power, both primary, and secondary to be de-activated with opening the main disconnect switch.
- The entire controller shall be UL 508A listed, INDUSTRIAL CONTROL PANELS, and have all UL listed devices of Touch Safe design, which shall eliminate any bare handed shock hazard. All primary and secondary power circuits shall be protected through the use of Touch Safe panel design.
- 3. All secondary control circuit wiring shall be 24 volts, AC/DC, or less, to include all pilot lights, selector switches, panel meters, HMI, PLC and alarm devices. The Primary motor branch circuits shall have thermal magnetic circuit breaker protection, (fuses shall not be acceptable). There shall be no part of the interior of the control enclosure, which shall produce a bare handed shock hazard even with the controller powered up. There shall be no exceptions to this requirement.
- 4. The controller shall utilize a programmable 24 volt EEPROM control module, which shall provide all pump staging, and timing functions. Low Suction and High System alarm conditions shall have audible and visual indicators, with timed delayed proof of condition and automatic reset. The EEPROM Module shall provide for automatic alternation between equal pumps. Pressure-based pump sequencing is unacceptable since a change in suction pressure can skew the lag sequencing point. Pump sequencing must be accomplished through electronic means allowing for the lag pump to carry the load prior to the lead handing off. Control system will guarantee PSI deviation of no more than +/- 1PSI on pump time-out alternation. Pump alternation shall enunciate on the main screen. There shall be no failure of any one system component which will render the system incapable of maintaining system flow to the building. All controls must be 100% fail-safe including failure of the PLC.
- 5. The controller panel shall have the following features:
 - a. NEMA 4, 256 color, 6" Touch Screen interface shall provide access to all timing, control and informational feedback on all system operations. This HMI shall provide for re-calibration of the system and all system parameters without the need to open the control panel door.
 - b. Touch screen shall include panel screen access to a logged alarm function with time and date stamp.
 - c. Touch screen shall incorporate a key logger able to save the last 400 button pushes in a non-volatile PLC memory.
 - d. Touch screen shall incorporate a PSI trending chart with the ability to export information including VFD speed, system PSI, KW, run times in an exportable CSV format on an externally removable USB flash drive.
 - e. All pump functions shall be accessible including Run Hours, Amperage, PSI and system temperature and remaining time until shutdown.
 - f. System shall provide for (optional) Ethernet IP communications including the ability to monitor and control the system remotely.
 - g. Provide three phase lightning protection for entire control panel.
 - h. Main power un-fused, door interlocked disconnect switch.
 - i. Individual, glycerin filled, panel mounted, stainless steel suction and system pressure gauges.
 - j. Low Suction Condition, and High System Pressure alarms, both audible, and visual
 - k. Automatic pump alternation between equal split pumps.
 - I. Low suction condition shall be initiated via a separate dedicated pressure switch(for

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pressure feed systems), or a liquid level float switch, (for break tank operation). All control components shall be UL Listed, or recognized devices.

n. The controller shall be UL 508 Listed, and in accordance with the National Electrical Code, (NEC).

Note: All components shall be of standard manufacture, and not be of proprietary sole source. Manufacturer will have these spare parts available either through local product representation or directly from the manufacturer via Next Day shipping.

- F. Pump Sequencing: All pump sequencing shall be initiated and controlled via the PLC. Upon pressure drop, the Lead pump shall initiate and run to attempt to satisfy demand. An empty pipe condition is to be determined by an algorithm allowing for a slow ramp to set point to prevent system pressure shocks. In the event the pressure set point is not satisfied or the pump is being overloaded, an additional pump shall immediately initiate to assist the lead pump in meeting demand. After the pressure set point is reached, the pumps shall continue to meet demand, if demand decreases, a sensor less means of control shall immediately shut down the pump to prevent no flow conditions and to prevent short cycling of the pumps. These algorithms take into account system pressure and system demand, the system shall revert to the stand-by mode (no flow shutdown) when no flow is present. A continuously monitored motor FLA algorithm shall prevent any motor from overloading and initialize additional pumps to share system demand. The system shall employ algorithms to detect pipe break and stop system, initiate an alarm and log the event. In the event of a sensor loss, the system shall run one pump in a semi-automatic mode allowing the building to maintain a minimum pressure until the sensor can be repaired or replaced. An automated PID algorithm shall continuously monitor system pressure and auto-tune the PID based on demand allowing for fast system demand response while maintaining smooth steady state pressure. The PID algorithms shall incorporate intelligent algorithms to start the pumps at the point of creating pressure saving energy and reducing time to set pressure upon pump call.
- G. The system shall not require external flow meters or KW monitoring. The system will not implement speed, thermal or time delay means to detect and shut down pumps on a no demand condition as this wastes energy and provides for unnecessary run times.
- H. Bladder Tank: No bladder tank is recommended, or required for this type system as there is no pressure change at the discharge of the pump. Since there is no pressure change, a tank is unusable in a variable speed booster application.
- I. Pressure Regulation: Pressure regulation is provided via the variable frequency drive controllers, with PID control. No other pressure regulators are required. In the event of any drive failure, next drive in sequence shall start automatically and the failed drive shall indicate a fault condition. In the event of a loss of transducer signal, the system shall be pre-programmed to a fail-safe mode which will ramp pumps to a safe-speed and maintain positive pressure on the system piping without shutting the system down. All system and drive settings shall be re-settable from the HMI (touch screen) including PID values without the need to open the controller door.
- J. Fabrication:
 - 1. All headers, nipples, and welded attachments to the headers shall be type 304 stainless steel materials.
 - 2. All welding shall be in accordance with section IX of the ASME Boiler and Pressure Vessel code, and shall be performed by welders qualified under that standard
 - 3. The completed system shall be hydrostatically and performance tested to simulated jobsite conditions and pre-set for plug and play operation. Copies of these test reports shall be

provided in the O&M Manuals which will be turned over to the owner. These manuals shall included all settings, explanation of these operations and final test reports from the factory test

- 4. Each pump shall have an individual resilient seated non-slam type check valve on each pump immediately downstream of the pump discharge.
- 5. All pumps shall be mounted utilizing in-shear rubber vibration isolators mounted to the motor bases
- 6. All stainless steel surfaces shall feature a consistent brushed metal finish so that all exposed stainless surfaces are identical in material finish.
- K. Start-Up:
 - 1. Initial factory start-up, and owner training shall be performed by a qualified factory trained technician. A factory certified start-up report must be provide to the owner, dated and signed by the factory technician.
- L. Parts: A complete listing of <u>all</u> components in the manufacture of the equipment shall be provide in the O&M including individual factory part numbers for each component in the packaged equipment.
- M. Owner Training: The owner instruction, and training shall include, but not be limited to the following:
 - 1. Training in the replacement of the motor, mechanical seals and pump impeller.
 - 2. Safe replacement of electrical components.
 - 3. Proper operation of the system, troubleshooting, alarm, and reset features
- N. On-Site Factory Warranty: Provide 1-year Factory warranty for defects in materials and workmanship. Warranty shall cover the failure of any equipment in accordance with factory warranty certificate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps complete with all accessories as shown or described on the construction documents.
- B. Install pumps with adequate working clearance around all components and accessories.
- C. Notify the Architect or Engineer of any conflicts between the manufacturer's recommendations and construction documents.

END OF SECTION 22 11 23

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SECTION 22 13 16 - 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. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Section also covers condensate drain piping for air conditioning system drains. All requirements within this section are applicable to condensate drain piping.
- C. Related Sections include the following:
 - 1. Division 22 Section 22_05_48 "Vibration <u>Controls</u> for Plumbing, Piping and Equipment."
 - 2. Division 22 Section 22_05_29 "Hangers and Supports for Plumbing, Piping and Equipment."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

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1.4 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.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Action Submittals:
 - 1. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 " Sustainable Design Requirements – LEED V4 BD+C"
 - Product Data: Documentation for Leadership Extraction Practices in the following:
 a. Leadership Extraction Practices for Recycled Content.
 - 3. Product Data: Documentation for Low emitting Materials (interior only).
 - a. Low emitting Materials for Adhesives and Sealants.
- C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturer: Subject to compliance with requirements, provide products from the listed manufacturers.

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2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - a. Leadership Extraction Practices for Recycled Content.
 - b. Material Cost data for all Hubless Cast Iron Pipe and fittings.
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, castiron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.4 STEEL PIPE AND FITTINGS

- A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content.
 - 2. Material Cost data for all Steel Iron Pipe and fittings.
- B. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- C. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- D. Pressure Fittings:

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- 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
- 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with balland-socket, metal-to-metal, bronze seating surface; and female threaded ends.
- 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
- 4. Cast-Iron Flanges: ASME B16.1, Class 125.
- 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
- E. Grooved-Joint Systems:
 - 1. Manufacturers:
 - a. Victaulic Co. of America.
 - b. Owner-approved substitution.
 - 2. Grooved-End, Steel-Piping Fittings: ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
 - 3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.5 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.
 - 1. Material: EPDM, unless NBR is indicated.

2.6 COPPER TUBE AND FITTINGS

- A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content.
 - 2. Material Cost data for all Copper Pipe and fittings.
- B. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

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- 2. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- 3. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
- 4. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- 5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- 6. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-andsocket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 POLYVINYLIDENE FLUORIDE DRAINAGE PIPE AND FITTINGS

- A. PVDF Drainage Pipe and Fittings: ASTM F 1673, pipe and drainage-pattern fittings, with Schedule 40 dimensions, with fusion- and no-hub mechanical-joint ends.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
 - b. Sloane, George Fischer Inc.
 - c. Town & Country Plastics, Inc.
 - d. Zurn Plumbing Products Group; Chemical Drainage Systems.

2.8 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2.9 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleevetype, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Co.
 - d. Plastic Oddities, Inc.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
 - c. Owner approved substitution.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducingor transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
 - c. Owner approved substitution.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.; DMD Div.
 - c. JCM Industries, Inc.
 - d. Romac Industries, Inc.
- 2. Center-Sleeve Material: Manufacturer's standard.
- 3. Gasket Material: Natural or synthetic rubber.
- 4. Metal Component Finish: Corrosion-resistant coating or material.
- E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron Sales, Inc.
 - b. Owner approved substitution.
- F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SIGMA Corp.
 - b. Owner approved substitution.

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- H. Dielectric Fittings:
 - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) McDonald, A. Y. Mfg. Co.
 - 3) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 4) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) Matco-Norca, Inc.
 - 3) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 4) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

- 3.1 EXCAVATION
 - A. Refer to Division 31 Section "Earth Moving<u>for Building Slabs</u>" for excavating, trenching, and backfilling.

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3.2 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste and vent piping shall be any of the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 4. Brass pipe or tube, chrome plated, where exposed in finished areas.
- D. Underground, soil, waste, and vent shall be any of the following:
 - 1. Solid Wall SCH 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground grease containing waste shall be one of the following:
 - 1. PVDF pipe with no-hub mechanical of fusion joint fittings.
 - 2. Stainless steel pipe and fittings.
 - 3. All grease waste piping to be protected with electric heat trace cable.
- F. Underground grease containing waste shall be one of the following:
 - 1. PVDF pipe with socket fusion joint fittings.
 - 2. Stainless steel pipe and fittings.
 - 3. All grease waste piping to be protected with electric heat trace cable.
- G. Aboveground acid containing waste (Spitoon sinks) shall be one of the following:
 - 1. PVDF pipe with no-hub mechanical of fusion joint fittings.
 - 2. Stainless steel pipe and fittings.
- H. Sump pump discharge shall be any of the following:
 - 1. Galvanized Steel pipe, pressure fittings, and threaded joints.

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3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division <u>22-33</u> Section "Facility Sanitary Gravity Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- G. 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 2 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.
- H. 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.
- I. 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 to NPS 6, 0.5 percent downward in direction of flow for piping NPS 8 and larger.

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ORLANDO INTERNATIONAL AIRPORT SOUTH TERMINAL C PHASE 1 (WS110)

- 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
- 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-ongrade if slab is without membrane waterproofing.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- M. Hubless piping shall be installed in a rigid, linear, and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.
 - 1. When horizontal hubless CI piping is suspended in excess of 18 inch by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.
 - 2. For all horizontal hubless CI piping 4-inch and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. 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.
- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section 22_05_19 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

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ORLANDO INTERNATIONAL AIRPORT SOUTH TERMINAL C PHASE 1 (WS110)

- 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
- 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install non-slam swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 22 Section 22_13_19 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. 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: 60 inches with 3/4-inch rod.

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- 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. 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 to 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.
- H. Install supports for vertical copper tubing every 10 feet.
- I. 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. 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.

3.8 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.

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- 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
- 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1316

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Air-admittance valves.
 - 5. Roof flashing assemblies.
 - 6. Through-penetration firestop assemblies.
 - 7. Miscellaneous sanitary drainage piping specialties.
 - 8. Flashing materials.
 - 9. Grease interceptors.
 - 10. Hair interceptors.
- B. Related Sections include the following:
 - 1. Division 22 Section 22 14 23 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.

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- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- 1.4 SUBMITTALS
 - A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 1. Grease interceptors.
 - 1. Grease interceptors.
 - B. Field quality-control test reports.
 - C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

- 2.1 BACKWATER VALVES
 - A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Josam Company; Josam Div.
- b. MIFAB, Inc.
- c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc., No. 7012.
- d. Zurn Plumbing Products Group; Specification Drainage Operation, No. Z1090.
- 2. Standard: ASME A112.14.1.
- 3. Size: Same as connected piping.
- 4. Body: Cast iron.
- 5. Cover: Cast iron with bolted access check valve.
- 6. End Connections: match piping.
- 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
- 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc., No. 7070.
 - c. MIFAB, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation, No. Z1091.
 - 2. Size: Same as floor drain outlet.
 - 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - 4. Check Valve: Removable ball float.
 - 5. Inlet: Threaded.
 - 6. Outlet: Threaded or spigot.
- C. Combined running-trap type valve with hub and spigot body, brass cleanout. Extend cleanout up and terminate in deckplate as noted, where valve is 18 inches or less below floor.
- D. For the noted size access pit provided under the General Construction Work, where valve is 19 inch or more below floor, 3-inch thick galvanized checkered steel flush cover held down with non ferrous screws and two drop-type flush lift handles. 2-inch x 2-inch galvanized welded angle iron frame with welded stops and lugs for anchoring into concrete. Turn frame over for setting under General Construction Work.
- E. Combination Gate Valve Type: Coated cast iron hub and spigot body, removable brass flap type backwater valve and seat, and non-rising stem gate, with cast iron cover and

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wheel handle. Provide valves modified with required extension stem and cast iron enclosing pipe up to floor level or grade level.

F. For Ejector Pump Discharge: Flanged IBBM swing type check valves with outside spring, 200 PSIG wog, equal to Kennedy Fig. 106LS.

2.2 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: as required to match connected piping.
 - 5. Closure: Countersunk brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. MIFAB, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 - 3. Size: Cast bronze cleanouts. Full size up to four inch, and at least half size for larger pipes, but with four inch minimum.
 - 4. Type: Adjustable housing.
 - 5. Body or Ferrule: Cast iron.
 - 6. Clamping Device: Required.
 - 7. Outlet Connection: Spigot.
 - 8. Closure: Brass plug with straight threads and gasket.
 - 9. Adjustable Housing Material: Cast iron.
 - 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 11. Frame and Cover Shape: Round.
 - 12. Top Loading Classification: Extra Heavy Duty.

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- 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: as required to match connected piping.
 - 5. Closure: Countersunk brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw or frame and cover.

2.3 FLOOR DRAINS

- A. Cast-Iron Floor Drains Except as Noted:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.6.3 with backwater valve.
 - 3. Pattern: see drawings.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Outlet: Bottom.
 - 9. Backwater Valve: Drain-outlet type.
 - 10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
 - 11. Sediment Bucket: see drawings.
 - 12. Top or Strainer Material: Nickel bronze.
 - 13. Top of Body and Strainer Finish: Polished bronze.
 - 14. Top Shape: Square.
 - 15. Dimensions of Top or Strainer: see drawings.

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- 16. Top Loading Classification: Heavy Duty.
- 17. Funnel: see drawings.
- 18. Inlet Fitting: see drawings.
- 19. Trap Material: Cast iron.
- 20. Trap Pattern: Standard P-trap.
- 21. Trap Features: Cleanout and trap-seal primer valve drain connection.

B. General:

- 1. In accordance with ANSI A112.21.1 and where required for the following construction types. For built up membrane, provide a flashing clamp. For liquid membrane, provide a four inch wide flange. For elastomeric type floor, provide a four inch wide top flange at required height. Provide strainers with a nickel bronze finish except as noted.
- 2. Provide a coated cast iron body, except as noted, with integral double drainage flange and weep holes, inside caulked outlet or hub outlet for compression gasket connection, or hubless outlet except as noted.
- Type FD-1, General, Shown Round: An adjustable extension neck and 6-inch diameter cast strainer, flashing clamp for membrane, equal to MIFAB 1100C, Smith No. 2010-A or Zurn ZN-415-6B. Type SD-1, Showers: 6-inch diameter strainers for 3-inch outlet size and five-inch diameter strainers for 2-inch outlet size.
- 4. Type **FD-2**, In machinery rooms and unfinished areas shown round, adjustable cast iron extension neck and tractor type top grate, equal to MIFAB F1320C, Smith No. 2320 or Zurn Z520.
- 5. Type **FD-3**, In machinery rooms and unfinished areas shown square, adjustable cast iron extension neck and maximum diameter bottom bar strainer on short legs, Smith No. 2230or Zurn Z540 and MIFAB 1340, Smith 2340 for 4 inch and 6-inch outlet modified without top grate or partial grate.
- 6. Type **FS**, Shown square in kitchens and where noted deep cast iron body sanifloor receptor with medium duty grate, white acid resistant porcelain enamel interior and top, complete with ABS anti-splash interior bottom dome strainer. Provide partially opened grate or funnel where required to receive indirect waste, equal to Zurn Z1910 or equal.
 - a. For drains receiving single indirect waste, provide strainer with matching 4inch diameter x 3-1/4 inch high secured funnel, equal Zurn Z-328-4.
 - b. For drains receiving multiple indirect wastes, provide with matching 83 inch x 33 inch x 3 inch high secured funnel, equal to Zurn Z-329-9.
 - c. Where indirect waste is too low for standard funnel, provide strainer with matching 6 inch x $2\frac{1}{2}$ inch x 1 inch high secured funnel, equal to Zurn-Z329-7.
 - d. Type FD-4, thorough flush drain: where indicated on the drawings provide equal to Zurn Z300, with integral double wall trap, cast iron body with acid resistant epoxy coated interior and exterior, side outlet, integral trap, seepage pan, slotted hinged grate.

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- e. Type FD-5, prison cell drain: where indicated on the drawings provide equal to Zurn Z355, Dura-coated cast iron body with side outlet, integral trap, anchor flange and adjustable slotted strainer secured with spanner type vandal proff screws.
- FD-6, detox cell drains: where indicated on the drawings provide equal to Acorn No.1699W, 14-gauge type 304 Stainless steel body with matte finish interior,
 1 inch male fluction connection, tran with 2 1/ inch acol. 2 2/8 inch O D

1-inch male flushing connection, trap with 3 $\frac{1}{2}$ -inch seal, 2 3/8-inch O.D. waste outlet with plain end.

2.4 FUNNEL DRAINS

- A. Chrome plated bronze funnel with rolled anti-splash lip including cast brass P-trap, equal to Mifab Fig. MI-950 F. Malleable iron reducer, bottom bar strainer, steel nipple and inlet cap with hole to form anti-splash lip, cast iron P-trap with all parts galvanized.
- B. Steel welding increaser, threaded outlet, welded inlet nipple and anti-splash lip, cast iron P-trap with all parts galvanized.
- C. 4-inch x 4-inch high chrome plated bronze funnel with dome bottom strainer and P-trap, equal to MIFAB FS1520-F4, Smith Series 3820 or Zurn ZN1019-CP.

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2.5 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. ProSet Systems Inc.
 - d. Studor, Inc.
 - 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 - 3. Housing: Plastic.
 - 4. Operation: Mechanical sealing diaphragm.
 - 5. Size: Same as connected fixture or branch vent piping.
- B. Stack Air-Admittance Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Durgo, Inc.
- b. Oatey.
- c. ProSet Systems Inc.
- d. Studor, Inc.
- 2. Standard: ASSE 1050 for vent stacks.
- 3. Housing: Plastic.
- 4. Operation: Mechanical sealing diaphragm.
- 5. Size: Same as connected stack vent or vent stack.
- C. Wall Box:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. Studor, Inc.
 - 2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
 - 3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.62.5 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, fully soldered stainless steel flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting. Refer to the architectural specifications for additional requirements.
 - 1. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.72.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. ProSet Systems Inc.
- 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 3. Size: Same as connected soil, waste, or vent stack.
- 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
- 6. Special Coating: Corrosion resistant on interior of fittings.

2.82.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-andspigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 - 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trapseal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
 - 6. Equal to MIFAB MI-GAP-1, Smith Fig. 3951orZurn ZANB-1025.

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- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- H. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.

2.92.8 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.

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E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.102.9 SHOWER PANS

- A. 6-lbs., pure sheet lead shower pans, watertight with 6-inch standing edges and corners folded and soldered, conforming with Architect's details. Pitch bottom of pan to drain and support securely with its clamping ring.
- B. For multiple sheets, seams joining sheets lapped ½ inch minimum in direction of flow and soldered with solder sweated between sheets to depth of overlap, or welded.
- C. Paint inside and out with a heavy coat of bitumen solution paint before setting, and set on ½ inch thick smooth, non-corroding bed of one part sand and one part portland cement.
- D. Chloraloy 240, chlorinated polyethylene sheeting.
- E. Watertight with 6 inch standing edges and corners folded and solvent welded or thermally welded.
- F. Conform with Architect's details.
- G. Bottom of pan pitched to drain and securely held by its clamping ring.
- H. Seams joining sheets: lapped 1/2 inch minimum in direction of flow.

2.112.10 GREASE INTERCEPTORS

- A. Grease Interceptors **GT**:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation or –processing wastewater.
 - 3. Plumbing and Drainage Institute Seal: Required.
 - 4. Body Material: Cast iron.
 - 5. Interior Lining: Corrosion-resistant enamel.
 - 6. Exterior Coating: Corrosion-resistant enamel.

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- 7. Body Dimensions: as indicated on the drawings
- 8. Body Extension: As required.
- 9. Flow Rate: as indicated on the drawings Capacity in first subparagraph below is limited to 200 lb.
- 10. Grease Retention Capacity: as indicated on the drawings
- 11. Cleanout: Integral
- 12. Mounting: As shown on drawings.
- 13. Flow-Control Fitting: Required.
- 14. Operation: Automatic recovery.

2.122.11 HAIR INTERCEPTORS

- A. Hair Interceptors HT:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Installed in SARA areas in lieu of the trap for the floor sinks serving the wash areas. Provide additional replacement bucket and screens.
 - 3. Characteristics:
 - a. Body Material: Acid resistant composite.
 - b. Sediment bucket: PVC.
 - c. Screen: Stainless steel with 3/32– inch openings.
 - 4. Similar to Zurn No. Z1180-SS-RS-Y.

2.132.12MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

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PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Where indicated on the drawings anchor grease interceptors to concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
 - 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
 - 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.2 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 100 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

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- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope, but not less than 1/2-inch total depression.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install fixture air-admittance valves on fixture drain piping.
- H. Install stack air-admittance valves at top of stack vent and vent stack piping.
- I. Install air-admittance-valve wall boxes recessed in wall.
- J. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- K. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- L. Assemble open drain fittings and install with top of hub 2 inches above floor.
- M. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- N. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- O. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

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- P. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- Q. Install vent caps on each vent pipe passing through roof.
- R. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- S. Install vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- T. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- U. Install wood-blocking reinforcement for wall-mounting-type specialties.
- V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- W. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding<u>"</u> for Electrical Systems."

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E. Connect wiring according to Division 26 Section "<u>Busways -</u>Low-Voltage <u>Electrical</u> <u>Power Conductors and Cables</u>."

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Grease interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

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END OF SECTION 22 1319

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section 22_14_29 "Sump Pumps."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Storm Drainage, Force-Main Piping: 50 psig.

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1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Action Submittals:
 - 1. Sustainable Design Documentatio Submittals: Refer to section 01 81 13.14 Sustainable Design Requirements – LEED V4 BD+C"
 - Product Data: Documentation for Leadership Extraction Practices in the following:
 a. Leadership Extraction Practices for Recycled Content.
 - Product Data: Documentation for Low Emitting Materials.
 a. Low emitting Materials for Adhesives and Sealants.
- C. Shop Drawings:
- D. Field quality-control inspection and test reports.
- 1.6 QUALITY ASSURANCE
 - A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
 - B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

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- 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
 - A. Pipe and Fittings: ASTM A 74, Service class.
 - B. Gaskets: ASTM C 564, rubber or elastomer.
 - C. Calking Materials: ASTM B 29, or hemp fiber.
- 2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS
 - A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content.
 - 2. Material Cost data for all Hubless Cast Iron Pipe and fittings.
 - B. Pipe and Fittings: ASTM A 888 or CISPI 301.
 - C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 6) Dallas Specialty & Mfg. Co.
 - 7) Logan Clay Products Company (The).
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 6) Dallas Specialty & Mfg. Co.
 - 7) Logan Clay Products Company (The).

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2.5 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- 2.6 STEEL PIPE AND FITTINGS
 - A. Product Data: Documentation for Leadership Extraction Practices in the following:
 - 1. Leadership Extraction Practices for Recycled Content. Recycled content value shall total no less than 35% post + ½ pre-consumer content of the material.
 - 2. Provide Material Cost data for all Steel Pipe and fittings.
 - B. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
 - C. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
 - D. Pressure Fittings:
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with balland-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 - E. Grooved-Joint Systems:
 - 1. Manufacturers:
 - a. Victaulic Co. of America.
 - b. Owner-approved substitution
 - 2. Grooved-End, Steel-Piping Fittings: ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
 - 3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

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2.7 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleevetype, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.

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- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducingor transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. ANACO.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.; DMD Div.
 - c. JCM Industries, Inc.
 - d. Romac Industries, Inc.
 - 2. Center-Sleeve Material: Manufacturer's standard.
 - 3. Gasket Material: Natural or synthetic rubber.
 - 4. Metal Component Finish: Corrosion-resistant coating or material.
- E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
- F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

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- 1. Manufacturers:
 - a. SIGMA Corp.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

PART 3 - EXECUTION

- 3.1 EXCAVATION
 - A. Refer to Division 31 Section "Earth Moving for Building Slabs" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. All uninsulated PVC piping exposed to exterior conditions shall be painted to provide UV protection. Painting shall be as recommended by the piping manufacturer. Coordinate with GOAA for required paint color.
- D. Aboveground storm drainage piping NPS 15 and smaller for all work except Parking Garage 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; standard, shielded, stainless-steel couplings; and coupled joints.
- E. Aboveground storm drainage piping NSP 16 and larger shall be Push-on-joint, ductileiron pipe; push-on-joint, ductile-iron fittings; gaskets; and gasketed joints.

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- F. Aboveground storm drainage piping for Parking Garage shall be the following:
 - 1. Solid Wall SCH 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.
- G. Underground storm drainage piping for all work shall be the following:
 - 1. Solid Wall SCH 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.
- H. Storm drainage force mains NPS 2-1/2 and NPS 6 shall be any of the following:
 - 1. Steel pipe, pressure fittings, and threaded joints.

3.3 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B.A. Basic piping installation requirements are specified in Division 22 Section 22_05_00 "Common Work Results for Plumbing."
- C.B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section 22_14_23 "Storm Drainage Piping Specialties."
- D.C. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E.D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section 22_05_00 "Common Work Results for Plumbing."
- F.E. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.
- G.F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- H.G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

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- <u>H.</u> Install manholes in lieu of cleanouts for piping NPS 8 and larger.
- Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- K.J. Install force mains at elevations indicated.
- <u>L.K.</u> Sleeves are not required for cast-iron soil piping passing through concrete slabs-ongrade if slab is without membrane waterproofing.
- M.L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- N.M. Hubless piping shall be installed in a rigid, linear and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.
 - 1. When horizontal hubless CI piping is suspended in excess of 18 inch by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.
 - 2. For all horizontal hubless CI piping 5-inch and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

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E. Grooved Joints: Cut groove ends of pipe and assemble grooved ends of pipes, groovedend fittings, and grooved-end-piping couplings according to AWWA C606.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section 22_05_23 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. 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 sump 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. Install backwater valves in accessible locations.
 - 3. Install backwater valves at all connections from air conditioning condensate drain main connection to storm system.
 - 4. Backwater valve are specified in Division 22 Section 22_14_23 "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section 22_05_29 "Hangers and Supports for Plumbing Piping and Equipment."

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- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. 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: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to 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.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. 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: 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. 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 to 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.
- J. Install supports for vertical copper tubing every 10 feet.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
- D. Connect force-main piping to the following:
 - 1. Storm Sewer: To exterior force main or storm manhole.
 - 2. Sump Pumps: To sump pump discharge.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

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- 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 5. Prepare reports for tests and required corrective action.
- 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.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1413

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- a. This Section includes the following storm drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Trench drains.
 - 4. Channel drainage systems.
 - 5. Through-penetration firestop assemblies.
 - 6. Roof drains.
 - 7. Area drains
 - 8. Miscellaneous storm drainage piping specialties.
 - 9. Flashing materials.
- b. Related Sections include the following:
 - 1. Division 22 Section 22_13_19 "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

- a. ABS: Acrylonitrile-butadiene-styrene plastic.
- b. FOG: Fats, oils, and greases.
- c. FRP: Fiberglass-reinforced plastic.
- d. HDPE: High-density polyethylene plastic.
- e. PE: Polyethylene plastic.
- f. PP: Polypropylene plastic.
- g. PUR: Polyurethane plastic.

- h. PVC: Polyvinyl chloride plastic.
- 1.4 SUBMITTALS
 - a. Product Data: For each type of product indicated.
- 1.5 QUALITY ASSURANCE
 - a. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 1.6 COORDINATION
 - a. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- a. Horizontal, Plastic Backwater Valves :
 - 1. Manufacturers: Subject to compliance with requirements, provide Zurn products No. BW2930 PVC or products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - 3. Size: Same as connected piping.
 - 4. Body: [PVC].
 - 5. Cover: Same material as body with threaded access to check valve.
 - 6. Check Valve: Removable swing check.
 - 7. End Connections: Socket type.
- For Sump Pump Discharge: Silent, double center guided, conical spring type check valves, flanged IBBM, 200 PSIG wog, equal to Williams Hager Clow Check Valve No. 329 for NPS 3 and smaller and No. 636 for NPS 4 and larger or Milwaukee Series 8800.

2.2 CLEANOUTS

- a. Exposed Metal Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: as required to match connected piping.
 - 5. Closure: Countersunk brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- b. Metal Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. Josam Company; Blucher-Josam Div.
 - 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 - 3. Size: Cast bronze cleanouts. Full size up to four inch, and at least-half size for larger pipes, but with four inch minimum.
 - 4. Type: Adjustable housing.
 - 5. Body or Ferrule: Cast iron.
 - 6. Clamping Device: Required.
 - 7. Outlet Connection: Spigot.
 - 8. Closure: Brass plug with straight threads and gasket.
 - 9. Adjustable Housing Material: Cast iron.
 - 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 11. Frame and Cover Shape: Round.
 - 12. Top Loading Classification: Extra Heavy-Duty.
 - 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- c. Cast-Iron Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.

- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: as required to match connected piping.
- 5. Closure: Countersunk brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 TRENCH DRAINS

- a. Trench Drains **TD**:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.6.3 for trench drains.
 - 3. Material: Ductile or gray iron.
 - 4. Flange: As required.
 - 5. Clamping Device: As required.
 - 6. Outlet: As shown or as required.
 - 7. Grate Material: Ductile iron.
 - 8. Grate Finish: Painted.
 - 9. Dimensions of Frame and Grate: As shown or scheduled on drawings.
 - 10. Top Loading Classification: As shown or scheduled on drawings.
 - 11. Trap Material: Cast iron.
 - 12. Trap Pattern: Standard P-trap.
- b. Roadway type TD-2: (frame and grate), heavy duty cast iron grate with fabricated steel frame, with anchor tabs, 6-inch wide and 20-inch long sections. , equal to Zurn ZN782-Z.
- c. Walkway Type TD-1: (frame and grate), medium duty dura-coated cast iron grate with fabricated steel frame, with anchor straps, 12-inch wide and 20-inch long sections., equal to Zurn ZN-792.
- 2.4 CHANNEL DRAINAGE SYSTEMS
 - a. Channel Drainage Systems TD-3:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hydrotech Technologies SIGMA, MAXI150.
 - b. MeaDrain Co., Supreme EN1500.
 - c. MultiDrain Systems.
- 2. Type: Modular system of **Polymer concrete** channel sections, **heavy duty ductile iron** grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

a. Standard: ASME A112.3.1, for trench drains.

- b. Channel Sections: Interlocking-joint..Dimensions: **6** inches wide interior. Include number of units required to form total lengths indicated.
- c. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: Ductile iron).
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
- d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
- e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.5 AREA DRAINS AD

- a. General:
 - 1. Manufacturers: Subject to compliance with requirements, provide Zurn Z512 or products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - 2. Standard: ASME A112.6.3 for trench drains.
 - 3. Material: Dura coated cas iron.
 - 4. Flange: required.
 - 5. Clamping Device: required.
 - 6. Outlet: bottom.
 - 7. Grate Material: Heavy duty cast iron tractor grate.
 - 8. Top Loading Classification: heavy duty.
- 2.6 FUNNEL DRAINS
 - a. Funnel Drains FUD-1

1. Manufacturers: Subject to compliance with requirements, provide Zurn No. Z326 or approved equal by one of the following:

- a). Josam Company; Josam Div.
- b). MIFAB, Inc.
- c). Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 2). Product details: Dura coated cast iron body indirect waste funnel drain.
- b. Funnel Drains FUD-2

1). Manufacturers: Subject to compliance with requirements, provide Zurn No. Z325 or approved equal by one of the following:

- a). Josam Company; Josam Div.
- b). MIFAB, Inc.
- c). Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2). Product details: Dura coated cast iron body with plastic ball float, integral bronze backwater valve bushing and replaceable neoprene seat.

- 1. For catch basins, provide a rectangular and square grate type with a precast reinforced concrete top slab instead of tapered top, and provide a flat reinforced concrete bottom slab as noted.
 - a. Curb type frame and grate 29-3/4 inch x 21-3/4 inch, equal to Flockhart Type 683 No. 60280 or Campbell No. 2540.

2.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- a. Through-Penetration Firestop Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 - 3. Size: Same as connected pipe.
 - 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 6. Special Coating: Corrosion resistant on interior of fittings.
- 2.8 ROOF DRAINS
 - a. Metal Roof Drains RD:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company; Josam Div.
- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.21.2M.
- 3. Pattern: Roof drain.
- 4. Body Material: Cast iron.
- 5. Combination Flashing Ring and Gravel Stop: Not required.
- 6. Flow-Control Weirs: Not required.
- 7. Outlet: Bottom.
- 8. Dome Material: Aluminum.
- 9. Extension Collars: Required.
- 10. Underdeck Clamp: Required.
- 11. Sump Receiver: Required.
- 12. Type **RD-2**, High capacity Deck Roof (Insulated Membrane): Dura coated cast iron bodiy, extension collar of required height with weep holes, combination membrane flushing clam/gravel guard and low silhouette dome, , equal to Zurn Z101-E. For overflow drain use 2-inch internal water dam Z-101-E-W2.
- 13. Type RD-1, Deck Roof (Insulated Membrane): Combination primary and overflow drain, dura coated cast iron bodies, extension collar of required height, combination membrane flushing clam/gravel guard and low silhouette dome equal to Zurn Z-163E.
- <u>14.</u> Type RD-3, Promenade cCanopy: <u>11-gauge spun aluminumDura-Coated cast</u> <u>iron body,</u> with combination membrane flashing clamp/gravel guard, Top set <u>deck plate, low silhouette Poly Dome, heavy duty cast aluminum strainer dome</u> and clamping ring (no underdeck clamp required), No-hub coupler with stainless steel bands for connection to cast iron, equal to OMG roofing products CDAL. Zurn100-DP.
- 14.15. For Canopy overflow RD-3 type drain add four-inch high internal water dam, Zurn100-DP-W4.
- <u>15.16.</u> Type RD-4 (Promenade deck): Square top, Dura coated cast iron body with rotatable squate frame, seepage openings, frame clamps and heavy duty heel-proof grate, equal to Zurn Z150-ZN.

2.9 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- a. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected piping.
- b. Conductor Nozzles:
 - 1. Description: Fabricated 304 stainless steel downspout nozzle with loose slotted, hinged cover and wall anchor mounting holes.
 - 2. Size: Same as connected conductor.
 - 3. Acceptable manufacturers: a. JR Smith No. 1775.

4. b. Josam Company; Josam Div.b. MIFAB, Inc.c. Zurn Plumbing Products Group

2.10 FLASHING MATERIALS

- a. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- b. Fasteners: Metal compatible with material and substrate being fastened.
- c. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- d. Solder: ASTM B 32, lead-free alloy.
- e. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- a. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- b. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- c. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- d. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- e. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

- f. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
- g. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- h. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- i. Install roof drains at low points of roof areas and where indicated according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
 - 3. Coated cast iron body roof drains with an inside caulked bottom outlet, except as noted and in accordance with ANSI A112.21.2.
 - 4. For liquid membrane roofs, use four inch wide flange, for built up membrane roofs, a combined flashing flange and gravel stop; and, for steel or precast decks, a deck clamp.
 - 5. Where insulation is applied over a structural roof deck, provide an extension collar with weep holes.
 - 6. For IRMA type roofs, 4 inch high, brass gravel guard, 16 inch diameter perforated with 1/4 inch holes.
 - 7. Provide tops of drains for decks and canopies with a bronze, nickel bronze, statuary bronze finish.
 - 8. For wood construction, provide drains with flashing clamps.
- j. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- k. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- I. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- m. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

a. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- a. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- b. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- c. Set flashing on floors and roofs in solid coating of bituminous cement.
- d. Secure flashing into sleeve and specialty clamping ring or device.
- e. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- a. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- b. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1423

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sump pumps and accessories, inside the building, for building storm drainage systems, condensate drainage pumps, and also elevator sump pit pumps, oil filters and oil monitoring systems:
 - 1. Wet-pit-mounted, vertical sump pumps.
 - 2. Submersible sump pumps.
 - 3. Sump pumps.
 - 4. Packaged, pedestal and submersible, drainage pump units.
- B. See Division 22 Section "Common Work Results for Plumbing" for information regarding condensate pumps :

1.3 SUBMITTALS

- A. Product Data: For each type and size of sump pump specified. Include certified performance curves with operating points plotted on curves, and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Line diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For each sump pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Retain shipping flange protective covers and protective coatings during storage.
 - B. Protect bearings and couplings against damage.
 - C. Comply with pump manufacturer's written rigging instructions for handling.
- 1.6 COORDINATION
 - A. Coordinate size and location of concrete bases and pits. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 WET-PIT-MOUNTED, VERTICAL SUMP PUMPS

- A. Manufacturers:
 - 1. Aurora Pump; Pentair Pump Group (The).
 - 2. Federal Pump Corp.
 - 3. Flyght Pumps.
- B. Description: Factory-assembled and -tested, single-stage, centrifugal, end-suction sump pumps complying with UL 778. Vertical, separately coupled, suspended pumps complying with HI 1.1-1.2 and HI 1.3 for wet-pit-volute sump pumps.
 - 1. Pump Arrangement: See plans and schedules.

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- 2. Casing: Cast iron, with screened inlet and threaded connection for NPS 2 and smaller and flanged connection for NPS 2-1/2 and larger discharge piping.
- 3. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced nonclog design; overhung, single suction, keyed and secured to shaft.
- 4. Pump Shaft and Sleeve Bearings: Stainless-steel shaft with bronze sleeve bearings. Include oil-lubricated, intermediate sleeve bearings at 48-inch maximum intervals if basin depth is more than 48 inches, and grease-lubricated, ball-type thrust bearings.
- 5. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- C. Pump Discharge Piping: Manufacturer's standard galvanized-steel or brass pipe.
- D. Pit Cover: Cast iron or steel with bituminous coating and strong enough to support pumps, motors, and controls. See Part 2 "Sump Pump Basins, Pits" Article for requirements.
- E. Cover Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- F. Motor: Single speed; grease-lubricated ball bearings. Comply with requirements in Division 22 Section 22_05_13 "Common Motor Requirements for Plumbing Equipment" with built-in thermal-overload protection appropriate for motor size and duty.
 - 1. Mounting: On vertical, cast-iron pedestal.
- G. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switches; with floats, float rods, and rod buttons. Include automatic alternator to alternate operation of pump units on successive cycles and to operate multiple units if one pump cannot handle load.
 - 1. Float Guide: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - 2. High-Water Alarm: Cover-mounted, mechanical-float-switch alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- H. Capacity and Characteristics (Refer to Pump Schedule on drawings)

2.3 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Federal Pump Corp.
 - 2. Liberty Pumps.
 - 3. Stancor, Inc.

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- B. Description: Factory-assembled and -tested, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.
- C. Pumps shall be duplex automatic vertical nonclog submersible centrifugal type with cast iron casing bolted to motor, and machined discharge flange, enclosed single vane nonclog type, epoxy coated, cast iron impeller mounted on motor shaft.
- D. Support pumps on machined mating flange on discharge elbow and on cast iron base. Galvanized steel guide bars complete with bracket for raising and lowering pumps or portable 'A' frame for raising and lowering pumps as scheduled.
- E. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.
- F. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, semiopen nonclog design, overhung, single suction, keyed and secured to shaft.
- G. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.
- H. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; threeconductor waterproof power cable of length required, and with grounding plug and cablesealing assembly for connection at pump. Comply with requirements in Division 22 Section 22_05_13 "Common Motor Requirements for Plumbing Equipment."
 - 1. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.
- I. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe or copper tube.
- J. Basin or Pit Cover: Cast iron or steel with bituminous coating and strong enough to support controls. See Part 2 "Sump Pump Basins and Pits" Article for other requirements.
- K. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switch; with float, float rod, and rod buttons.
- L. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switch; with float, float rod, and rod buttons. Include automatic alternator to alternate operation of pump units on successive cycles and to operate multiple units if one pump cannot handle load.
 - 1. Float Guide: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.

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- 2. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanicalfloat switch alarm matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- M. Capacity and Characteristics: Refer to Pump Schedule on drawings.
- N. Capacity and Characteristics: Refer to Pump Schedule on drawings.
- 2.4 SUMP PUMP PITS
 - A. Description: Concrete pit with sump, pipe connections, curb frame, and separate cover.
 - B. Sump: Construct of watertight, cast-in-place, reinforced concrete with sidewall openings for pipe connections. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Pipe Connections: Sleeved openings large enough for mechanical sleeve seals for drainage piping. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing," and drainage piping is specified in Division 22 Section "Facility Storm Drainage Piping."
 - C. Curb Frame and Cover:
 - 1. Curb Frame Material: Galvanized steel.
 - a. Pattern: Z-cross-section shape with raised outer rim of height matching cover, for recessed mounting having installed cover flush with top of floor slab.
 - 2. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - a. Material: Cast iron.
 - b. Reinforcement: Steel or cast iron, capable of supporting foot traffic for pits installed in foot-traffic areas.
 - 3. Coverplate or access door shall be walkway/roadway type with flush curb frame and hinged, lockable access door, hold open arm and locking device. Covers for subsoil drainage sump shall be airtight and gasketed.
 - 4. Access door shall be large enough to allow for pulling each pump, and for access into pit.
 - D. Capacity and Characteristics: (Refer to Pump Schedule on drawings).

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2.5 PACKAGED DRAINAGE PUMP UNITS

- A. Pedestal Units: Factory-assembled and -tested, single-stage, centrifugal, end-suction, automatic-operation, freestanding drainage pump unit.
 - 1. Manufacturers:
 - a. Goulds Pumps; ITT Industries.
 - b. Liberty Pumps.
 - c. Little Giant Pump Co.
 - d. Sta-Rite Industries, Inc.
 - e. Zoeller Company.
 - 2. Pump Body: Corrosion-resistant material.
 - 3. Impeller: Aluminum, brass, or plastic.
 - 4. Motor: With built-in overload protection and mounted vertically on sump pump column. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 5. Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches, with grounding plug and cable-sealing assembly for connection at pump.
 - 6. Control: Float switch.

2.6 ELEVATOR PIT SUMP PUMP SYSTEM

- A. Manufacturers:
 - 1. Stancor, Inc. Oil Minder S/L-75 O/M ELV.
 - 2. Zoeller.
- B. The Pump System allows water to be automatically pumped from hydraulic elevator pits or traction elevator sumps, without danger of ejecting potentially harmful oily substances into sewer system. There shall be no need for a separate oil-water separator.
- C. The System shall be designed for easy fool-proof installation. All pump and control cables shall be factory wired into a wall mountable junction box. Provide main control panel.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Metraflex, Inc.
 - 2. Owner approved substitution

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- B. Description: 125-psig (860-kPa) minimum working-pressure rating and ends matching pump connection:
 - 1. Bronze Flexible Connectors: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to tubing.
 - 2. Stainless-Steel Flexible Connectors: Corrugated, stainless-steel inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to tubing.

2.8 BUILDING AUTOMATION SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
 - 1. On-off status of each pump.
 - 2. Alarm status.

2.9 ALARM PANEL

- A. Remote-mounted alarm panel, equal to Weil 8301, shall consist of a single NEMA 1 enclosure complete with 3 indicating lights, reset buttons, alarm horn or bell and silencing switch. Lights shall be normally dim-glow and shall change to full-glow and sound the alarm under any of the following conditions:
 - 1. Power failure to the pump control panel.
 - 2. High water condition.
 - 3. Simultaneous two pump operation.
 - 4. Failure of either pump.
- B. Coordinate location and wiring of alarm panel with electrical contractor
- C. Wiring diagrams:
 - 1. Furnish and turn over to the Electrical Contractor, after review by the Engineer, complete wiring diagrams showing full details of the factory wiring.

2.10 CONTROL PANEL

- A. Combination unfused disconnect switch and across-the-line magnetic starter with overload protection for each phase leg, for each pump.
 - 1. Undervoltage protection.

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- 2. 120 volt control circuit transformer, fused on primary, and grounded on secondary, with automatic transfer between each pump's incoming supply in the event of failure or shutdown of power supply to any pump. Connections to pump incoming supplies shall be made downstream of controller disconnect devices.
- 3. Momentary contact push buttons marked MANUAL, for bypassing automatic control when held in (JOGGING).
- 4. Automatic electric alternator (four lead units).
- 5. Moisture sensing audible and visual alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 22 Section 22_05_00 "Common Work Results for Plumbing."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 SUMP PUMP INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving for Building Slabs."
- B. Install sump pumps according to applicable requirements in HI 1.4.
- C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

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- D. Suspend wet-pit-mounted, vertical sump pumps from basin and pit covers. Make direct connections to storm drainage piping.
- E. Set submersible sump pumps on basin or pit floor. Make direct connections to storm drainage piping.
- F. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.
- G. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.
- H. Install packaged, pedestal, drainage pump units and make direct connection to storm drainage piping.
- I. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.
- J. Support piping so weight of piping is not supported by pumps.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section 22_14_13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to sump pumps to allow service and maintenance.
- C. Connect storm drainage piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Division 22 Section 22_05_23 "Facility Storm Drainage Piping."
 - 1. Install flexible connectors adjacent to pumps in discharge piping.
 - 2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for drainage piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

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E. Connect wiring according to Division 26 Section "<u>Busways</u> - Low-Voltage <u>Electrical</u> <u>Power Conductors and Cables</u>."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify bearing lubrication.
 - 3. Disconnect couplings and check motors for proper direction of rotation.
 - 4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 5. Verify that pump controls are correct for required application.
- B. Start pumps without exceeding safe motor power:
 - 1. Start motors.
 - 2. Open discharge valves slowly.
 - 3. Check general mechanical operation of pumps and motors.
- C. Test and adjust controls and safeties.
- D. Remove and replace damaged and malfunctioning components.
 - 1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
 - 2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.
- E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1429

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SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following electric water heaters:
 - 1. Flow-control, electric, tankless, domestic-water heaters.
 - 2. Light duty-commercial electric, storage water heaters.
 - 3. Commercial, storage electric water heaters.
 - 4. Compression tanks.
 - 5. Water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. LEED V4 BD+C Submittal:
 - 1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1-2016, Section 7 "Service Water Heating."
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
- E. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- F. Source quality-control reports.

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- G. Field quality-control reports.
- H. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- I. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components Health Effects; Sections 1 through 9" and Annex F & G.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

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- a. Structural failures including storage tank and supports.
- b. Faulty operation of controls.
- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Period(s): From date of Substantial Completion:
 - a. Instantaneous, Tankless Electric Water Heaters: One year.
 - b. Light Duty-Commercial, Storage Electric Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Three years.
 - c. Commercial. Storage Electric Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Five years.
 - d. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- 2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS
 - 1. :
 - B. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - d. State Industries.

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- 2. Standard: UL 1453.
- 3. Storage-Tank Construction: Steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
- 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - g. Temperature Control: Adjustable thermostat.
 - h. Efficiency: 98%.
 - i. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - j. Relief Valves: ASME rated and stamped for combination temperature-andpressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction.
- C. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - d. State Industries.
 - 2. Standard: UL 174.

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- 3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
- 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-andpressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater workingpressure rating. Select relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction with legs for off-floor installation.
- D. Capacity and Characteristics: Refer to schedule on plans.

2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bosch Water Heating.
 - b. Chronomite Laboratories, Inc.
 - c. Eemax, Inc.
 - d. Stiebel Eltron, Inc.
 - 2. Standard: UL 499 for electric, tankless, domestic-water heater heating appliance.
 - 3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

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- a. Connections: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig.
- c. Heating Element: Resistance heating system.
- d. Temperature Control: Flow-control fitting.
- e. Safety Control: High-temperature-limit cutoff device or system.
- f. Jacket: Aluminum or steel with enameled finish or plastic.
- 4. Support: Bracket for wall mounting.
- 5. Capacity and Characteristics: Refer to schedule on drawings.

2.4 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL Inc.
 - b. Honeywell International Inc.
 - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - d. State Industries.
 - e. Taco, Inc.
 - 2. Description: Steel pressure-rated tank constructed with welded joints and factoryinstalled butyl-rubber diaphragm. Include air precharge to minimum systemoperating pressure at tank.
 - 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: Refer to schedule on plans.
 - c. Air Precharge Pressure: Static water pressure less 5 psig, unless otherwise noted.
- B. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inchhigh, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.

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- C. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- D. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- E. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 gardenhose threads.
- F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- G. Heat-Trap Fittings: ASHRAE 90.2.
- H. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
 - 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - 2. Comply with requirements for balancing valves specified in Division 22 Section "Domestic Water Piping Specialties."
- I. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- J. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- K. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- L. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- M. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- N. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension

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that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

O. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements<u>Control</u>" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 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.

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- 8. Anchor domestic-water heaters to substrate.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domesticwater heaters at least 18 inches above floor on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."
- G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domesticwater heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-

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water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

- I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill electric, domestic-water heaters with water.
- K. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 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.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.
- C. Prepare test and inspection reports.

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3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 3300
SECTION 22 37 00 – POTABLE WATER CABINET

PART 1 – GENERAL

- 1.1 GENERAL DESCRIPTION
 - A. This section of the specifications covers the following components:
 - 1. Potable Water Cabinet

1.2 REFERENCES

- A. Applicable Standards:
 - 1. National Fire Protection Associated (NAPA):
 - 2. National Electrical Manufacturer's Association (NEMA).
 - 3. Occupational Safety and Health Act (OSHA).
 - 4. Underwriters Laboratories (UL).
 - 5. Florida Building Code (FBC).

1.3 SUBMITTALS

A. See section 01 3323 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1.4 QUALITY ASSURANCE

- A. NFPA Compliance.
- B. NEMA Compliance.
- C. UL Compliance: All internal components shall be UL-listed and labeled.
- D. Comply with the all applicable Local Building Codes.

PART 2 - PRODUCTS

2.1. CABINET

- A. Manufacturer: Semler Industries, Inc. Model S1-10500 or approved equal.
- B. Material: Stainless steel, Type 304, 16 gauge, #4 finish interior and exterior.
- C. Construction: Welded double wall construction throughout, including bottom and doors with 1" polystyrene insulation. Welded and ground joints, rounded corners, brushed and polished interior and exterior. Cabinet to be provided with:

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- 1. 1-1/2" NPS fitting for drain (located at the bottom center of cabinet)
- 2. Penetration for 1" water connection (located at back wall of cabinet)
- 3. Penetration for 1" electrical connection (located at back wall of cabinet)

No support braces or equipment to be mounted on bottom of cabinet to impede drainage or cabinet cleaning.

2.2. DOORS

- A. Material: Stainless steel, Type 304, 16 gauge, #4 finish interior and exterior.
- B. Construction: Double wall construction, welded and ground joints, rounded corners, polished interior and exterior with 1" insulation between inside and outside walls. Two-point door latch with stainless steel recessed locking D-ring handle and full length stainless steel piano hinge with top mounted stainless steel door holder/closer.
- 2.3. MOUNTING
 - A. Shall be mounted on the Passenger Boarding Bridge wheel bogie on the side closest to the aircraft.

2.4. ELECTRICAL

- A. All components mounted within the cabinet shall be UL listed or recognized, weather proof, suitable for service at 120 volts.
- B. Light: 100 watt equivalent LED fixture, weatherproof-vapor proof, with guard and onoff switch.
- C. Heaters: None
- D. 15 A. 120 VAC GFCI duplex service outlet with waterproof cover.
- E. All wiring enclosed in flexible "Sealtite" conduit or rigid galvanized conduit. Provide one (1) 115 Volt, 1 Phase, 15 amp circuit for each cabinet.
- F. Hose Reel: Hannay Model RXX60-0046-D or approved equal, 1" bronze swing joint, bronze internal piping, aluminum drum, stainless steel disks and poly-coated frame. Reel includes ½ HP 115 volt, explosion-proof electric rewind motor with horsepower rated momentary contact control switch. Auxiliary hand rewind crank to be provided. Adjustable reel drag brake. Reel mounted to back wall of cabinet. Reel capacity ¾ x 300' or 1" x 200'.
- G. Potable Water Cabinet shall be NRTL listed and marked as required by federal regulations.

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August 10, 2018 Revision #22 H. Circuits to be provided at face of building by others. Materials, devices and equipment for electrical connection of Potable Water Cabinet shall meet Florida Building Code and U.L. requirements.

2.5. PIPING COMPONENTS

- A. Nozzle: Semler model #PWC-1-MNZ or approved equal, long barrel coupler with plug/drag cushion, stainless steel nylon coated security cable, control valve and protective bumpers.
- B. Shut-off Valve: 1" bronze ball valve with Teflon seat and stainless steel ball.
- C. Pressure Regulator: Conbraco, 1" bronze adjustable 25-75 PSI or approved equal.
- D. Pressure Gauge: 2-1/2" 0-100 PSI bronze internals and brass case.
- E. Pipe Fittings: Bronze, threaded ANSI B16.15.
- F. Piping: 1" schedule 40 Brass ASTM Specification B43-91.
- G. Connector: 1" x 8" 304 stainless steel flexible connector to relieve piping stress on hose reel swivel joint.
- H. Hose: ³/₄" x 200' drinking water hose Model 075-3150 with FDA-CFR title #2 parts #170-199 or approved equal.
- I. Water connection shall be the equivalent nominal pipe size copper tubing as backflow preventor at face of building (backflow preventor by others).

END OF SECTION 22 37 00

SECTION 22 40 00 - PLUMBING FIXTURES

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 WORK IN THIS SECTION

- A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for the following:
 - 1. Plumbing fixtures and trim, faucets, other fittings and related components.

1.3 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Dishwasher air-gap fittings.
 - 7. Water closets and accessories.
 - 8. Urinals and accessories.
 - 9. Lavatories and accessories.
 - 10. Stainless steel sinks and accessories.
 - 11. Water filters and accessories.
 - 12. Commercial sinks.
 - 13. Garbage disposals.
 - 14. Individual showers.
 - 15. Hot water dispensers.
 - 16. Service sinks.
 - 17. Mop receptors.
 - 18. Owner-furnished fixture trim.
 - 19. Toilet accessories.
 - 20. Emergency Eyewash Showers.

- 21. Eyewash Units.
- 22. Ablution bath.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section 22_11_19 "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 31 Section 22_11_13 "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes culturedmarble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.5 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements LEED V4 BD+C".

C. Product data

- 1. Product Data for low emitting adhesives and sealants.
- 2. Documentation indicating flow and water consumption requirements.
- 3. Water flow sense label compliance.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities; A117.1, "Specifications for making buildings and facilities accessible to and usable by physically handicapped people".
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Mop-Service Basins: ANSI Z124.6.
 - 4. Plastic Shower Enclosures: ANSI Z124.2.
 - 5. Plastic Sinks: ANSI Z124.6.

- 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
- 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
- 8. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
- 9. Stainless-Steel Residential Sinks: ASME A112.19.3.
- 10. Vitreous-China Fixtures: ASME A112.19.2M.
- 11. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- 12. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Faucets: ASSE 1016.
 - 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hand-Held Showers: ASSE 1014.
 - 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 7. Hose-Coupling Threads: ASME B1.20.7.
 - 8. Manual-Control Antiscald Faucets: ASTM F 444.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Pressure-Equalizing-Control Faucets: ASTM F 444 and ASSE 1016.
 - 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 12. Thermostatic-Control Faucets: ASTM F 444 and ASSE 1016.
 - 13. Temperature Actuated Flow Reduction Valves for Individual Fittings: ASSE 1062.
 - 14. Individual Pressure Balancing In-line Valves for Individual Fixture Fittings: ASSE 1066.
 - 15. Automatic Temperature Control Mixing Valves: ASSE 1069.

- 16. Water Temperature Limiting Devices: ASSE 1070.
- 17. EPA standards for water sense label requirements.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 - 4. Manual-Operation Flushometers: ASSE 1037.
 - 5. Plastic Tubular Fittings: ASTM F 409.
 - 6. Brass Waste Fittings: ASME A112.18.2.
 - 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Disposers: ASSE 1008 and UL 430.
 - 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 - 3. Flexible Water Connectors: ASME A112.18.6.
 - 4. Floor Drains: ASME A112.6.3.
 - 5. Grab Bars: ASTM F 446.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Hot-Water Dispensers: ASSE 1023 and UL 499.
 - 8. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Plastic Toilet Seats: ANSI Z124.5.
 - 11. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.7 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
 - 4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 - 5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
 - 6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
 - 7. Toilet Seats: Equal to 5 percent of amount of each type installed.
 - 8. Dry Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
 - 9. Dry Urinal Trap-Seal Liquid: Equal to 1 gal for each urinal installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets LF-1:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or by one of the following:
 - a. Hydrotek: No. H-5000E with AC adapter.
 - b. -Other Owner approved WaterSense labeled substitute.
 - 2. Description: Single-control nonmixing valve; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.35 gpm.
 - d. Centers: Single hole with 4 inches centers for three point anchoring.
 - e. Mounting: Deck, exposed.
 - f. Inlet(s): NPS 3/8 tubing, plain end.
 - g. Spout: Rigid type.
 - h. Spout Outlet: Aerator 0.35 gpm.
 - i. Operation: Sensor.

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- j. Drain: Grid.
- k. Tempering Device: None.
- I. Preset for 12 seconds operation.
- B. Lavatory Faucets LF-2:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or by one of the following:
 - a. Hydrotek: No. 5000EM.
 - b. -Other Owner approved WaterSense labeled substitute.
 - 2. Description: Single-hole deck mounted sensor operated with hot/cold mixing adjustments, with mixing valve; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm.
 - d. Centers: Single hole with 4 inches centers for three point anchoring.
 - e. Mounting: Deck, exposed.
 - f. Valve Handle(s): Not applicable.
 - g. Inlet(s): NPS 3/8 tubing, plain end.
 - h. Spout: Rigid type.
 - i. Spout Outlet: Aerator 1.5 gpm aerator.
 - j. Operation: Sensor.
 - k. Drain: Grid.
 - I. Tempering Device: Thermostatic.
 - m. Preset for <u>30-12</u> seconds operation.
- C. Lavatory Faucets LF-3:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or by one of the following:
 - a. Hydrotek: No. 5000EM.
 - b. Other Owner approved WaterSense labeled substitute.
 - 2. Description: Single-hole deck mounted sensor operated with hot/cold mixing adjustments, with mixing valve; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0. 35 gpm.
 - d. Centers: Single hole.
 - e. Mounting: Deck, exposed.
 - f. Valve Handle(s): Not applicable.
 - g. Inlet(s): NPS 3/8 tubing, plain end.

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<u>h.</u> Spout: Rigid type.
<u>i.</u> Spout Outlet: Aerator 0.35 gpm.
<u>j.</u> Operation: Sensor.
<u>k.</u> Drain: Grid.
<u>I.</u> Tempering Device: Thermostatic.
n.m. Preset for 12 seconds operation.

C.D. Lavatory Supply Stops:

1. 3/8 inch lockshield angle type stops with slow compression cartridge and loose key. Wall type supply faucets shall include integral or built-in stops.

2.2 SHOWER FAUCETS

- A. Shower Faucets :
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Speakman NEO No. SM-1000-P pressure balance Valve and trim with Kohler No. K-11637-H shower head. Complete with Kohler No. K-7397-CP 7-1/2 inch arm, flange, or comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Other Owner approved WaterSense labeled substitute.
 - 2. Description: Single-handle pressure-balance valve. Include hot- and coldwater indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - a. Body Material: Solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm.
 - d. Diverter Valve: Integral with mixing valve.
 - e. Mounting: Exposed.
 - f. Backflow Protection Device for ADA Hand-Held Shower: Required.
 - g. Operation: Single-handle, twist or rotate control.
 - h. Antiscald Device: Integral with mixing valve.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - j. Supply Connections: NPS 1/2.
 - k. Shower Head Type: See plumbing fixture schedule.
 - I. Shower Head Material: Metallic with chrome-plated finish.
 - m. Spray Pattern: Adjustable.
 - n. Integral Volume Control: Not required.
 - o. Shower-Arm Flow-Control Fitting: See plumbing fixture schedule.
 - p. Temperature Indicator: Not required.
- B. Shower Faucets, HSH:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler No. K-72587 1.5 gpm shower head and slide bar.
- 2. Lever diverter shall be modified for ADA shower, located adjacent to mixing valve, 48 inches maximum above floor.
- 3. Kohler No. K-98343-CP 36-inch chrome plated brass bar and adjustable bracket type.
- 4. Shower accessories
- a. Kohler No. K-98343-CP 4436-inch chrome plated brass bar and adjustable bracket type.
- b. Kohler No. K-9514 60-inch flexible metal shower hose and adjustable hand held shower with aerated spray.

2.3 SINK FAUCETS

- A. Sink Faucets:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay No. LKD2439C or Owner approved substitution.
 - 2. Description: Kitchen faucet without spray. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Backflow Protection Device for Hose Outlet: N/A.
 - f. Backflow Protection Device for Side Spray: N/A.
 - g. Centers: 8 inches.
 - h. Mounting: Deck.
 - i. Handle(s): Wrist blade, 4 inches.
 - j. Inlet(s): NPS 3/8 plain-end tubing.
 - k. Spout Type: Swivel gooseneck.
 - I. Spout Outlet: Aerator.
 - m. Vacuum Breaker: Not required.
 - n. Operation: manual.
 - o. Drain: Pop up.
- B. Service Sink:
 - 1. Wall-mounted combination faucet with integral stops, wall brace, pail hook, 3/4-inch hose thread end, and vacuum breaker, equal to Speakman No. SC-5811.
- C. Mop Sink:

- 1. Wall-mounted combination faucet with integral stops, wall brace, pail hook, 3/4-inch hose thread end, and vacuum breaker, equal to Speakman No. SC-5811-RCP modified with 30-inch plain end rubber hose with wall bracket.
- D. Shop Sinks:
 - 1. Combination wall type supply fittings with vandal-proof aerator nozzle, twoinch spray head, integral stops and metal soap dish with.
 - a. Swing spout, equal to Speakman No. S-5732-1S.
 - b. Gooseneck spout, equal to Speakman No. SC-5744 cross handles (aerator) with four arm handles, No. SC-5744-SO (spray head), with four arm handles.
- E. Animal Relief hose spray:
 - 1. Single water temperature Meter-Matic cartridge valve body, Push button operation, adjustable timer setting 5-60 seconds. Installation at 48 inches maximum above floor. With flexible 60-inch long stainless steel hose and adjustable hand held shower with aerated spray.
 - 2. Complete installation with 44-inch chrome plated brass bar. Finish: Chrome plated or stainless steel.
 - 3. Manufacturer: Acorn Type 7 valve with FX type shower head.

2.4 FLUSHOMETERS

- A. Flushometers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Hydrotek No. HB-8-128DF for toilets and H8-B1.125 for urinals, or by one of the following:
 - a. Other Owner approved WaterSense labeled substitute. .
 - 2. Description: Flushometer for urinal and water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: piston operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 3/4 (urinal) NPS 1 (water closet).
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 0.125 gal./flush (urinal); 1.1/ 1.28 gal./flush dual flush type (water closet).
 - f. Tailpiece Size: NPS 3/4 (urinal); NPS 1-1/2 (water closet).

2.5 TOILET SEATS

- A. Toilet Seats:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the Centoco Model 500ST SCC or Owner approved substitution.
 - 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check.
 - e. Class: Standard commercial.
 - f. Color: White.

2.6 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing Co., Inc.
 - b. TRUEBRO, Inc.
 - c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hotand cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.7 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 5. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
 - 1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as

required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- 2. Concealed adjustable extra heavy cast iron combination drainage fitting and chair carriers with an adjustable base anchored to slab using all base support holes, rear anchor foot assembly for stud walls, adjustable cast iron outlet nipple and/or coupling, neoprene gasket and steel supporting bolts with chrome plated washers and cap nuts.
- C. Urinal Supports:
 - 1. Description: Type II, urinal carrier with hanger and bearing plates for wallmounting, urinal-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
 - 3. Concealed adjustable iron chair carrier with bearing plate and steel supporting bolts, with 3-inch x 1-inch rectangular uprights welded to base.
- D. Lavatory Supports:
 - 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.

2.8 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings :
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
 - a. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
 - b. Brasstech Inc.; Newport Brass Div.
 - c. Watts Brass & Tubular; a division of Watts Regulator Co.
 - 2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
 - 3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.9 WATER CLOSETS TYPE WC and HWC

- A. Basis-of-Design Product: Subject to compliance with requirements, American Standard No. 2634.101 or Owner approved substitution.
- B. Description: Accessible, wall-mounting, wall outlet, vitreous-china fixture designed for flushometer valve operation.
- C. Style: One piece.
 - 1. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 2. Height: Accessible.
 - 3. Design Consumption: 1.1 / 1.28 gal. / flush, dual flush.
 - 4. Trip Mechanism: Sensor.
 - 5. Color: White.

2.10 URINALS UR

- A. Basis-of-Design Product: Subject to compliance with requirements, Kohler No. K-4991-ER-0 or a comparable product by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Zurn Plumbing Products Group; Commercial Brass Operation.
- B. Description: Accessible and standard, wall mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Type: Siphon jet.
 - 2. Strainer or Trapway: Integral cast strainer with integral trap.
 - 3. Design Consumption: 0.125 gal/flush.
 - 4. Color: White.
 - 5. Supply Spud Size: NPS 3/4.
 - 6. Outlet Size: NPS 2.
 - 7. Fixture Support: Urinal chair carrier

2.11 PUBLIC LAVATORIES

A. LAVATORY L2

1. Basis of Design Product: Subject to compliance with requirements, provide American Standard No. 9141.047 or Owner approved substitution.

- 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With back.
 - b. Size: 20 by 18-1/4 inches rectangular.
 - c. Faucet type: LF1.

- c.d. Faucet Hole Punching: One hole..
- d.e. Faucet Hole Location: Top.
- e.f. Color: White.
- f.g. Supplies: NPS 3/8 chrome-plated copper with stops.
- <u>g.h.</u> Drain: See faucet.
- h.i. Drain Piping: NPS 1-1/4 thick tubular brass waste to wall; and wall escutcheon.
- B. LAVATORY L1.

1. Basis of Design Product: Subject to compliance with requirements, provide Dupont Corian No. 810 or Owner approved substitution.

2. Description: Accessible, counter-mounting, vitreous-china fixture.

- a. Type: Corian
- b. Size: 16-1/2 by 13 BY 5-1/2 inches deep.
- b.c. Faucet type LF 1 for public restrooms and LF2 for Family and Nursing rooms.
- e.d. Faucet Hole Punching: none.
- d.<u>e.</u>Color: Bisque.
- e.f. Supplies: NPS 3/8 chrome-plated copper with stops.
- f.<u>g.</u> Drain: See faucet.
- <u>g.h.</u> Drain Piping: NPS 1-1/4 thick tubular brass waste to wall; and wall escutcheon.

C. LAVATORY L3

1. Basis of Design Product: Subject to compliance with requirements, provide American Standard No. 9024.001 EC or Owner approved substitution.

- 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With back.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet type: LF1.
 - c.d. Faucet Hole Punching: One hole..
 - d.e. Faucet Hole Location: Top.
 - e.f. Color: White.
 - f.g. Supplies: NPS 3/8 chrome-plated copper with stops.
 - g.h. Drain: See faucet.
 - h.i. Drain Piping: NPS 1-1/4 thick tubular brass waste to wall; and wall escutcheon.

2.12 HOT-WATER DISPENSERS

A. Instant Hot Water Dispensers, Type HWD:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or Owner approved substitution.
- 2. Locations: Pantry sinks.
- 3. Description: Gooseneck spout with lever-handle, flow control, household-type dispenser with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric heating element; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F; and thermal-overload protection.
 - a. Storage Tank Capacity: 0.5 gal. minimum.
 - b. Heating Element: 750 W minimum, 115-V ac.

2.13 SINKS

- A. Pantry Sinks Type P.SK:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Elkay Manufacturing Co. No. LRDA221965PD-MR2 Lustertone.
 - b. Owner approved substitute.
 - 2. Description: One bowl 18 Gauge stainless-steel kitchen sink.
 - a. Overall Dimensions: 22" X 19-1/2" X 6-1/2" deep.
 - b. Faucet holes: two faucet and hot water dispenser.
 - c. Drain: 3-1/2-inch crumb cup.
 - a) Location: Centered in bowl.
 - c. Supplies: NPS 1/2 chrome-plated copper with stops.
 - d. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; tubular brass waste to wall; and wall escutcheon(s).
- B. Service Sinks Type S.SK:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Elkay Manufacturing Co. No. ESS25202.
 - b. Owner approved substitute.
 - 2. Description: Single bowl 14 Gauge 304 stainless-steel wall mounted sink.
 - a. Overall Dimensions: 25" X 19-1/2" X 12" deep.
 - b. Backsplash: 12" high.
 - c. Faucet holes: two.

- d. Drain: 3-1/2-inch with strainer.
- e. Location: Centered in bowl.
- f. Supplies: NPS 1/2.
- g. Drain Piping: NPS 3 cast-iron P-trap with off floor support; waste to wall; and wall escutcheon.
- h. Faucet: refer to service sink faucet.

2.14 TOILET ACCESSORIES

- A. By general construction contractor.
- 2.15 SERVICE BASINS Type MS.
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide Fiat No. TSB-100 or a comparable product by one of the following:
 - 1. Florestone Products Co., Inc.
 - 2. Stern-Williams Co., Inc.
 - B. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 24 by 24 inches.
 - c. Height: 12 inches.
 - d. Tiling Flange: On three sides.
 - e. Rim Guard: On all top surfaces.
 - f. Color: Not applicable.
 - g. Drain: Grid with NPS 3 outlet.

2.16 SECURITY COMBINATION UNITS Type SCU

- A. Combination Units: Front access, on floor, cabinet, with water closet and lavatory.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Acorn Engineering Company No. 1449 or comparable product by one of the following:
 - a. Bradley Corporation.
 - b. Metcraft Industries Inc.
 - 2. Material: 0.078-inch- minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.
 - 3. Finish: ASTM A 480/A 480M, No. 4 polished finish on exposed surfaces.
 - 4. Cabinet: Rectangular apron Four-sided apron with angled side, with backsplash and access panel.
 - a. Water-Closet Bowl Location: See architectural floor plans for bowl orientation.

- 5. Mounting: Bolts through wall sleeve into accessible service space.
- 6. Water Closet:
 - a. Standard: IAPMO PS 61.
 - b. Bowl:
 - 1) Type: Elongated, with back inlet, integral trap, and blowout design with back outlet and contoured seat.
 - 2) Seat Surface: ASTM A 480/A 480M, No. 7 polished finish.
 - 3) Punching: Two holes for installation of separate toilet seat.
 - 4) Outlet Connection: N/A.
- 7. Lavatory:
 - a. Standard: ASME A 112.19.3/CSA B45.4.
 - b. Location: In top of cabinet.
 - c. Receptor: Oval bowl with integral soap depression.
 - d. Hot- and Cold-Water and Bubbler Supply Valves: Mechanical-metering type with push-button actuation and individual check stops complying with ASME A112.18.1/CSA B125.1.
 - e. Filler Spout: Backsplash mounted.
 - f. Drain: Integral punched grid with NPS 1-1/4 minimum waste and trap complying with ASME A112.18.2/CSA B125.2.
- 8. Wall Sleeve: N/A.

2.17 EMERGENCY SHOWER WITH EYEWASH COMBINATION UNITS ESH

- A. Standard, Plumbed Emergency Shower with Eyewash Combination Units:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Bradley Corporation.
 - b. Haws Corporation.
 - c. Speakman Company.
 - 2. Piping:
 - a. Material: Galvanized steel, factory painted.
 - b. Unit Supply: NPS 1-1/4 minimum.
 - c. Unit Drain: Outlet at back or side near bottom.
 - 3. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod.

- d. Shower Head: Standard flow control shower head, plastic.
- e. Mounting: Pedestal.
- 4. Eyewash Unit:
 - a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Spray-Head Assembly: Two receptor-mounted spray heads.
 - e. Receptor: Chrome-plated brass or stainless-steel bowl.
 - f. Mounting: Attached shower pedestal.
 - g. Drench-Hose Option: May be provided instead of eyewash unit.
 - 1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - 2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
 - 3) Mounting: Bracket on shower pedestal.

2.18 EYEWASH UNIT EEW

- A. Standard, Wall-Mounted, Plumbed Face/Eyewash Units:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Haws Corporation No. 7361-7461 or comparable product by one of the following:
 - a. Bradley Corporation.
 - b. Speakman Company.
 - 2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - 3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - 4. Control-Valve Actuator: Paddle.
 - 5. Spray-Head Assembly: Two receptor-mounted spray heads.
 - 6. Receptor: Stainless-steel bowl, 11-inch Dia.
 - 7. Drain Piping: NPS 1-1/4 minimum, galvanized receptor drain/pedestal, complying with ANSI Z358.1.
 - 8. Mounting: Floor mounted pedestal type.

2.19 WASHING MACHINE OUTLET BOX

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Siux Chief No. 696-G2313XF or a comparable product by one of the following:
 - 1. Watts.
 - 2. IPS Corporation.
- B. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.

- a. Shape: Recessed, dual box combination.
- b. Frame: White, durable.
- c. Support: Galvanized steel bracket and box clip.
- d. Drain: 3/4 male garden hose tread outlets.
- e. Water connections: ¹/₄ turn lever handle ball valves with water hammer arresters, color coded ¹/₂-inch female sweat inlet connections.

2.20 ABLUTION FOOT BATH

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Wudu Mate-M or a comparable product by one of the approved manufacturers.
- B. Description: Prefabricated modular design for traditional position for seated wudu combined with optional standing positions; configured for wheelchair access,
 - a. Material: Sanitary-grade, reinforced acrylic and stainless steel.
 - b. Finish: high-quality sanitary grade acrylic.
 - c. Color: white.
 - d. Seat top: double skin, sanitary grade acrylic.
 - a. Seat post: stainless steel
 - b. Drain: Stainless steel strainer, with offset shower waste outlet.
- C. Ablution tap: Time delay wall mounted tap, with Neoperl pressure equalizing aerator, 1/4 turn on/off mechanism at the end of spout, Wudu Mate #WM-TMV3 thermostatic mixing valve, chrome plated finish.

2.21 COMMERCIAL GARBAGE DISPOSAL

- A. Basis-of-Design Product: Subject to compliance with requirements, provide InSinkEratorSS-300 or a comparable product by one of the following:
 - 1. Salvajor.
 - 2. Owner approved substitute.
- B. Description: Multi-grind 2-stage technology, sound seal performance, with sink top switch.
 - a. Capacity: 34.6 OZ.
 - b. Power: 3 HP, 208-230V, 3 Phase.
 - c. Control panel InSinkErator No. AS_101:
 - 1). Automatic shut-off with power loss.
 - 2). Line disconnect.
 - 3). Programmable post-flush.
 - 4). Timer.

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5). Automatic regulation of water flow.

2.22 SPITOON SINK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kraus No. KHF200-30 or a comparable product by one of the following:
 - 1. Elkay Manufacturing Co.
 - 2. Owner approved substitute.
- B. Description: One bowl 16 Gauge stainless-steel kitchen sink with apron front.
 - 1. Installation: undermount.
 - 2. Overall Dimensions: 29-3/4" X 20-3/4" X 10" deep.
 - 3. Faucet holes: faucetless
 - 4. Drain: 3-1/2-inch crumb cup.
 - 5. Location: Centered in bowl.
 - 6. Drain Piping: stainless steel or PVDF.

2.22 FIXTURE CONNECTION SCHEDULE

- C. Sizes of branch piping shall be not less than listed below. Actual connection sizes shall be as required by connection on fixtures.
- D. Water closets: Drain: 4 inch, vent: 2 inch, CW: 1 inch.
- E. Urinals: Drain: 2 inch, vent: 1¹/₂ inch, CW: ³/₄ inch.
- F. Lavatories: Drain: 1¹/₂ inch, vent: 1¹/₂ inch, CW: 3/8 inch, HW: 3/8 inch.
- G. Sinks: Drain: 2 inch, vent: 1¹/₂ inch, CW: ¹/₂ inch, HW: ¹/₂ inch.
- H. Service sinks: Drain: 3 inch, vent: 1¹/₂ inch, CW: ³/₄ inch, HW: ³/₄ inch.
- I. Mop sinks: Drain: 3 inch, vent: 1¹/₂ inch, CW: ³/₄ inch, HW: ³/₄ inch.
- J. Washing machine outlet box: Drain: 3 inch, vent: 1¹/₂ inch, CW: ³/₄ inch, HW: ³/₄ inch.
- K. Ablution Bath: Drain: 1¹/₂ inch, vent: 1¹/₂ inch, CW: ¹/₂ inch, HW: ¹/₂ inch.Ice makers: CW: 3/8 inch.
- L. Eye wash: Drain: 1¹/₂ inch, vent: 1¹/₂ inch CW: 1/2 inch.
- M. Emergency shower and eye wash combination unit: Drain outlet: 1¹/₄ inch, CW: 1¹/₄ inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 NSTALLATION

Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

- 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
- 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
- 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- 4. Lag fixture carrier base plates or feet to slab with lead expansion shields and insert bolts in all bolt holes.
- 5. Where wall hung water closets are supported adjacent to stud walls, provide rear anchor foot assembly bolted to slab.

Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

Install wall-mounting fixtures with tubular waste piping attached to supports.

Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

Install counter-mounting fixtures in and attached to casework.

Install fixtures level and plumb according to roughing-in drawings.

- Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

- Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - N. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach. Adjust flushometer valves to be plumb vertically.
 - O. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
 - P. Install toilet seats on water closets.
 - Q. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - R. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - S. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
 - V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- <u>V.W.</u> Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- W.X. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- X.Y. Ground equipment according to Division 26 Section "Grounding and Bonding."
- <u>Y.Z.</u> Connect wiring according to Division 26 Section "Busways Low-Voltage".

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Refer to section 01 74 23 "Final cleaning" for cleaning procedure protocol.
- B. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

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C. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 TESTING AND COMMISSIONING

- A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Divisions 01, 23 and 26 further details.
- B. System functional testing is part of the Commissioning Process. Functional testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority. Refer to Section 01 Section on Commissioning, for system functional tests and commissioning requirements.

3.8 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4000

SECTION 22 47 00 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following water coolers and related components:
 - 1. Pressure water coolers.
 - 2. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Electric Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- F. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Line diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; A117.1: "Specifications for making buildings and facilities accessible to and usable by physically handicapped people" for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects; Sections 1 through 9" and Annex F & G for fixture materials that will be in contact with potable water.
- D. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to 100 percent of amount installed for each type and size indicated.

PART 2 - PRODUCTS

- 2.1 PRESSURE WATER COOLERS
 - A. Water Coolers, EWC:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Filtrine No. FC-107-16-SOOOO, with TM1-05 filter or a comparable product by one of the following:
 - a. Elkay Manufacturing Co.

- b. Halsey Taylor.
- c. Haws Corporation.
- d. Murdock Mfg.
- e. Oasis Corporation.
- 2. Type EWC: Description: ARI 1010, Type PB, pressure with bubbler, Style FW, flush-to-wall water cooler.
 - a. Cabinet: All stainless steel satin finish.
 - b. Bubbler: One, with adjustable stream regulator, located on deck, soft touch button.
 - c. Control: Sensor operated.
 - d. Bottle filling station: Vandal proof, sensor activated, mounted 10 inch above lowest bowl.
 - e. Bottle rest: to be located above lowest bowl.Supply: NPS 3/8 with ball, gate, or globe valve.
 - f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for 0.5 gph flow rate.
 - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: 5 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
 - 2) Electrical Characteristics: 115-V ac; single phase; 60 Hz.
 - i. ADA compliant.
 - j. Filtrine Model numbers:
 - 1) Single unit FC-107-16, mounted at ADA height
 - 2) Double unit FC-16-HL-VP
 - 3) Triplex unit FC-16-HHL-VP

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

- 1. Type I: Hanger-type carrier with two vertical uprights.
- 2. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
 - 1. On block walls, fasten wall hanger to 18 inch by 4 inch built-in iron backing plates,
 - a. equal to Smith No. 825 modified (tile walls) and to Smith No. 826 modified.
 - 2. Fasten wall hanger to concealed adjustable iron chair carrier. For block walls, use supports
 - a. equal to Smith No. 830.
 - 3. For stud walls, use supports
 - a. equal to Smith No. 830-M31, with 3 inch by 1 inch rectangular uprights welded to base.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section 22_05_23 "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deeppattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section 22_05_00 "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildewresistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding". for Electrical Systems."
- D. Connect wiring according to Division 26 Section "<u>Busways -</u> Low-Voltage". <u>Electrical</u> Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

- 3.7 CLEANING
 - A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
 - B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 22 4700

SECTION 22 70 00 – NATURAL FUEL GAS SYSTEMS - PLUMBING

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.
 - 6. Dielectric fittings.
 - 7. Sleeves.
 - 8. Mechanical sleeves.
 - 9. Escutcheons.
 - 10. Pressure gauges.
 - 11. Low pressure switches.
 - 12. Alarms and monitors.
 - 13. Labeling and identification.
 - 14. Grout.
 - 15. Cathodic protection.
 - 16. Concrete bases.

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.

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1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 125 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 125 psig minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 125 psig.
- B. Natural-Gas System Pressure within Buildings: 4 inches WC to 3 psig.

1.5 SUBMITTALS

- A. Shop Drawings Provide product data for each type of the following:
 - 1. Piping
 - 2. Fittings
 - 3. Joints.
 - 4. Piping specialties
 - 5. Corrugated, stainless-steel tubing with associated components.
 - 6. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 7. Pressure regulators. Indicate pressure ratings and capacities.
 - 8. Service meters including supports
 - 9. Dielectric fittings.
 - 10. Mechanical sleeve seals.
 - 11. Escutcheons.
 - 12. Supports
- B. Coordination Drawings: Plans and details, drawn to 1/4 scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- D. Qualification Data: For qualified professional engineer.
- E. Welding certificates.

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- F. Field quality-control reports.
- G. Operation and Maintenance Data: For gas valves pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Refer to section 22_05_00.
- B. Reference Standards:
 - 1. Florida Building Code.
 - 2. NFPA No. 54 National Fuel Gas Code latest edition.
 - 3. Local utility requirements.
 - 4. Published Specifications' standards, tests or recommended methods of trade, industry or governmental organizations.
 - 5. American Gas Association (AGA).
 - 6. Compressed Gas Association (CGA).
 - 7. Military Standard Spec. (MSS).
 - 8. Underwriters Laboratory.
 - 9. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 10. Pipe Welding Qualifications: Qualify procedures and operators according to ASME IX Boiler and Pressure Vessel Code latest edition.
 - 11. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven (7) days in advance of proposed interruption of natural-gas service.
 - 2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."
- C. Provide valved gas piping for heating, ventilating and air conditioning equipment to within ten (10) feet of equipment connections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Exterior wall sleeves:
 - 1. Innerlinks.
 - 2. Thunderline.
- B. Steel pipe and fittings:
 - 1. Crane Co.
 - 2. National Tube Co.
 - 3. Republic Steel Co.
 - 4. Allied Steel.
- C. Fittings:

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- 1. Crane Co.
- 2. Tube Turn.
- 3. Walworth.
- 4. Allied Steel.
- D. Gas vent terminals:
 - 1. Acme Scales Co., Inc.
 - 2. Richards Manufacturing.
 - 3. UPSCO, Inc.
- E. Hangers and supports:
 - 1. Anvil International.
 - 2. Michigan Hanger (Erico).
 - 3. PSI Corp.
 - 4. B-Line.
 - 5. Carpenter & Patterson, Inc.
- F. Paint:
 - 1. Sherwin Williams.
 - 2. Pittsburgh Plate Glass Co.
 - 3. Pratt & Lambert.
- G. Valves:
 - 1. Plug valves (Gas Cocks):
 - a. Conbraco Industries.
 - b. A.Y. McDonald Mfg. Co.
 - c. Crane Co.
 - d. DeZurik Healy Co.
 - e. Nordstrom Valves, Inc.
 - f. Walworth Co.
- H. Natural Gas Alarms:
 - 1. Mine Safety Appliances.
- I. Carbon Monoxide Alarms:
 - 1. Mine Safety Appliances.
 - 2. S-Tech Division of Patrick Plastics, Inc.
 - 3. G.E. Interlogix.

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- 4. Kidde.
- J. Pressure Gauges:
 - 1. Trerice Co.
 - 2. U.S. Gage.
 - 3. Weiss.

2.2 PIPING

A. Inside steel piping:

- 1. For low pressure 0.5 PSIG or less use standard weight black steel pipe with 150 PSIG threaded malleable iron fittings for piping 2 in. and smaller.
- 2. For low pressure 0.5 PSIG or less use steel welded fittings for piping 2-1/2 in. and larger.
 - a. All in accordance with ANSI Z223.1; NFPA-54 and Florida Building Code; whichever is more stringent.
- 3. For pressure (0.5 PSIG to 3 PSIG) use black steel pipe and steel welded fittings for piping 4 in. and larger and threaded for piping under 4 in.
- 4. For pressure above 3 PSIG, all piping shall be welded.
- B. Underground piping:
 - 1. Steel pipe with Dresser type and steel welding fittings. Pre-wrap with Mill-wrapped corrosion protection extruded polyolefin coating in accordance with Gas Company requirements, equal to Energy Coating Co. or PlexCo.
 - 2. High density polyethylene pipe and fittings in accordance with ASTM D-2513, Grades 2306, 3306, and 3408 with fusion joints only, equal to Driscopipe 8100-DRII Series.
- C. Underground drips shall be AGA and local gas company approved and shall be cast iron or tar coated welded steel pots with adjustable tar coated cast iron extension shaft and flush box with lock type extra heavy cast iron cover marked GAS DRIP.
- D. In no case shall any gas pipe be less than ³/₄ inch.

2.3 GAS VENT TERMINALS

A. ³/₄ in. and one (1) in. aluminum threaded vent terminal with 16 x 16 mesh 0.018 gauge stainless steel screen.

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- B. 1¹/₄ in. to 4 in. standard pipe threaded elbow with 12 x 12 mesh stainless steel screen.
 - 1. Equal to UPSCO, Inc.
- C. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welded 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 welded to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum orings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 6. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining steel pipe to steel pipe.
 - f. Steel body couplings installed underground on pipe shall be factory equipped with anodes.
- D. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

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2.4 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Corrugated stainless-steel tubing with polymer coating.
 - 4. Operating-Pressure Rating: 0.5 psig.
 - 5. End Fittings: Zinc-coated steel.
 - 6. Threaded Ends: Comply with ASME B1.20.1.
 - 7. Maximum Length: 72 inches.
- B. Weatherproof Gas Vent Terminal Caps: 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.
- C. ³/₄ in. and one (1) in. aluminum threaded vent terminal with 16 x 16 mesh 0.018 gauge stainless steel screen.
- D. 1¹/₄ in. to 4 in. standard pipe threaded elbow with 12 x 12 mesh stainless steel screen.
 - 1. Equal to UPSCO, Inc.

2.5 PIPE AND TUBING JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural fuel 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.

2.6 VALVES

- A. Manual Shut-off Valves Inside Building
- 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 where required by Con. Ed.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.

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- 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- 7. Threaded cast iron body, 125 PSIG wog
 - a. Equal to Nordstrom Fig. 114.
- 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 where required by Con. Ed.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
 - 5. 2¹/₂ in. to 4-in.: Flanged cast iron body lubricated tapered plug type, 175 PSIG wog.
 - a. Equal to Nordstrom Fig. 115.
 - 6. 6 in. and larger: Flanged cast iron body lubricated tapered plug type, 200 PSIG wog, worm gear operated.
 - a. Equal to Nordstrom Fig. 165.
- D. Provide 2 wrenches for each size used.
 - 1. Attach wrench to each valve.
- E. Ball Valves
 - 1. On local branches three inches and smaller, provide threaded three piece full port wafer-type ball valve with bronze body, ball stem, Teflon seats, and level handles, 300 PSIG wog.
 - a. Equal to Contromatics No. C-1111-AA.
- F. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. 2 inch and smaller: Threaded brass ball valves with full port TFE sears and blowout proof stem, 600 psig wog.
 - a. Equal to NIBCO N: T-FP-600.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.

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- c. Lyall, R. W. & Company, Inc.
- d. McDonald, A. Y. Mfg. Co.
- e. NIBCO.
- f. Perfection Corporation; a subsidiary of American Meter Company.
- 3. Body: Bronze, complying with ASTM B 584.
- 4. Ball: Chrome-plated bronze.
- 5. Stem: Bronze; blowout proof.
- 6. Seats: Reinforced TFE; blowout proof.
- 7. Packing: Threaded-body packnut design with adjustable-stem packing.
- 8. Ends: Threaded, flared, or socket.
- 9. CWP Rating: 600 psig.
- 10. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 11. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Check Valves:
 - 1. Provide bronze body swing disc check valve.
 - a. Equal to Eclipse Series 1000.
- H. Bronze Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond
 - b. Lee Brass Company.
 - c. McDonald, A. Y. Mfg. Co.
 - d. NIBCO
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Plug: Bronze.
 - 4. Ends: Threaded, socket, or flanged.
 - 5. Operator: Square head or lug type with tamperproof feature where indicated.
 - 6. Pressure Class: 125 psig.
 - 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- I. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. McDonald, A. Y. Mfg. Co.
- b. Mueller Co.; Gas Products Div.
- c. Xomox Corporation; a Crane company.
- 2. Body: Cast iron, complying with ASTM A 126, Class B.
- 3. Plug: Bronze or nickel-plated cast iron.
- 4. Seat: Coated with thermoplastic.
- 5. Stem Seal: Compatible with natural gas.
- 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 7. Operator: Square head or lug type with tamperproof feature where indicated.
- 8. Pressure Class: 125 psig.
- 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- J. Cast Lubricated Plug Valves Inside Building:
 - 1. 2-inch and smaller: Cast iron body, threaded, equal to Nordstrom Valves, Inc. Figure 114.
 - 2. 2¹/₂ inch to 4-inch: Flanged cast iron body lubricated tapered plug type, 175 PSIG wog, equal to Nordstrom Valves, Inc. Figure 115.
 - 3. Valves 2 ¹/₂ inch and larger shall be flanged.
 - 4. Provide 2 wrenches for each size used.
 - 5. Attach wrench to each valve.
 - 6. Gas Cocks:
 - a. Gas cocks shall be for use only as manual gas shut-off valves at each piece of gas burning equipment; shall be of the plug type, bronze construction with check, nut and washer bottom and tee handle.
 - b. Gas cocks shall be Figure 10596 as manufactured by A.Y. McDonald Mfg. Co., or Series 52 as manufactured by Conbraco Industries, Inc.
 - c. Gas cocks shall only be used on piping 1 inch and smaller.

2.7 MOTORIZED GAS VALVES

- A. Automatic Gas Valves: Comply with ANSI Z21.21.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ASCO or comparable product by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Dungs, Karl, Inc.
 - c. Eaton Corporation; Controls Div.

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- d. Eclipse Combustion, Inc.
- e. Honeywell International Inc.
- f. Johnson Controls.
- g. G. Maxon.
- 2. Body: Brass or aluminum.
- 3. Seats and Disc: Nitrile rubber.
- 4. Springs and Valve Trim: Stainless steel.
- 5. Normally closed.
- 6. Visual position indicator.
- 7. Electrical operator for actuation by appliance automatic shutoff device.

2.8 GAS SAFETY SHUT-OFF VALVES

- A. Gas safety shut-off valves shall be FM & UL listed, electric motor operated, normally closed, manual reset type. Valves shall be rising stem design with a straight through flow path with metal-to-metal seat and disc arrangement. The valve seat shall be stainless steel and the disc ductile iron. Valves shall be provided with a NEMA 4 enclosure modified for Class I, Division II hazardous locations, be provided with an electrical terminal block and shall operate on 120 Volt, A.C., 60 Cycles, single phase. Valves shall meet ANSI Class VI leakage standard and shall be provided with a visual indicator to note the position of the valve whether "OPEN" or "SHUT."
- B. Gas safety shut-off valves 2" and smaller shall be threaded, 2 1/2" and larger shall be flanged. Flanged valves shall be provided with companion flange set by valve manufacturer.
 - 1. Gas safety shut-off valves 2" and smaller
 - a. Equal to Maxon Corporation Series 808.
 - 2. 2 1/2" and larger. All valves shall be provided with trim package 1-1.
 - a. Equal to Series 808-CP.
- C. Gas safety shut-off valves shall be installed in the following locations:
 - 1. On the firm gas line downstream of its meter and before any branch take-offs.
- D. Gas safety shut-off valves shall be wired to the gas leak detection system and shall function to shut off all gas supply to the building upon:
 - 1. Action of the gas leak detection system (alarm condition) would cause immediate power shut-down.

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2. Loss of normal electrical power.

2.9 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. Service Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Invensys.
 - e. Richards Industries; Jordan Valve Div.
 - 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 - 6. Orifice: Aluminum; interchangeable.
 - 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 - 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 - 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 - 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 - 12. Maximum Inlet Pressure: 60 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Eclipse or comparable product by one of the following:

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- a. Actaris.
- b. American Meter Company.
- c. Eclipse Combustion, Inc.
- d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
- e. Invensys.
- f. Maxitrol Company.
- g. Richards Industries; Jordan Valve Div.
- 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
- 3. Springs: Zinc-plated steel; interchangeable.
- 4. Diaphragm Plate: Zinc-plated steel.
- 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
- 6. Orifice: Aluminum; interchangeable.
- 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
- 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
- 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
- 10. Overpressure Protection Device: Factory mounted on pressure regulator.
- 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
- 12. Maximum Inlet Pressure: 1 psig.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Maxitrol Co. or comparable product by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

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- 9. Maximum Inlet Pressure: 1 psig.
- 2.10 GAS (SERVICE) METERS
 - A. By local utility company.
- 2.11 DIELECTRIC FITTINGS
 - A. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - f. Wilkins; Zurn Plumbing Products Group.
 - 2. Minimum Operating-Pressure Rating: 150 psig.
 - 3. Combination fitting of copper alloy and ferrous materials.
 - 4. Insulating materials suitable for natural gas.
 - 5. Combination fitting of copper alloy and ferrous materials with threaded, brazedjoint, plain, or welded end connections that match piping system materials.
 - B. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - d. Wilkins; Zurn Plumbing Products Group.
 - 2. Minimum Operating-Pressure Rating: 150 psig.
 - 3. Combination fitting of copper alloy and ferrous materials.
 - 4. Insulating materials suitable for natural gas.
 - 5. Combination fitting of copper alloy and ferrous materials with threaded, brazedjoint, plain, or welded end connections that match piping system materials.
 - C. Dielectric-Flange Kits:

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
- 2. Minimum Operating-Pressure Rating: 150 psig.
- 3. Companion-flange assembly for field assembly.
- 4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
- 5. Insulating materials suitable for natural gas.
- 6. Combination fitting of copper alloy and ferrous materials with threaded, brazedjoint, plain, or welded end connections that match piping system materials.

2.12 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.13 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers: Subject to compliance with requirements, METRAFLEX or a comparable product by one the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

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2.14 MECHANICAL GAS SLEEVES

- A. Carbon steel, zinc chromate bolts and nuts with corrosion inhibiting coating.
- B. Seal material EPDM, black in color.
- C. Pressure pates of reinforced nylon polymer.
- D. Equal to Thunderline Link Seal Model 'C'.

2.15 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chromeplated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chromeplated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.16 PRESSURE GAUGES

A. 4½ in. diameter, black enamel coated steel case ring with shatterproof glass, ½ in. bronze bellows with brass socket, blow out on back of case, ¼ in. bottom outlet connection, similar to Trerice No. 860 or Weksler Instruments Corp. No. BL14-PWE4-LWXX with 0 to 27 in. of water column dial, brass pressure snubber and brass tee-handle cock.

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- B. Locate pressure gauges on inlet and outlet of gas booster pressure pump, at farthest point in system and as noted.
- 2.17 ALARMS AND MONITORS
 - A. Natural Gas Monitor
 - 1. Explosion-proof stainless steel, infrared gas (carbon monoxide) detector with display, monitor controller and external power supply.
 - a. Equal to Ultima XIR Gas Monitor.
 - 2. Additional power supply to convert AC to DC.
 - a. Equal to Ultima Power Supply No. 815320, 80 to 132 volts AC.
 - 3. Wire to building management system alarm and shut down gas safety shut off valve.
- 2.18 GROUT
 - A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.19 UNDERGROUND 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.

2.20 CATHODIC PROTECTION

A. Provide a complete electrically isolated, cathodic protection system for entire length of underground gas line, including all components, suitable for temperatures and pressures involved.

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- B. Prior to installation, conduct a corrosion site survey using a qualified corrosion engineer to evaluate soil conditions and establish system requirements.
- C. System shall be the sacrificial magnesium anode type with 17 lb anodes, spacing based upon soil resistivity readings, with a maximum spacing of 300 feet Pack anodes in permeable cloth bag in backfill: 75% ground hydrated gypsum, 20% powdered Wyoming bentonite, 5% anhydrous sodium sulfate.
- D. Magnesium anodes shall be high current type with magnesium wall having the following composition:
 - 1. Aluminum: 5.3 to 6.7%.
 - 2. Manganese: 0.15% minimum.
 - 3. Zinc: 2.5 to 3.5%.
 - 4. Silicone: 0.3% maximum.
 - 5. Copper: 0.02% maximum.
 - 6. Nickel: 0.003% maximum.
 - 7. Iron: 0.003% maximum.
 - 8. Other impurities: 0.3% maximum.
 - 9. Magnesium: Remaining.
- E. Anodes shall be cast with perforated galvanized steel strap core. One end of anode shall be recessed so one end of strap is accessible for lead wire connection. Anode lead wires shall be 25 feet long, silver soldered to strap core and with a minimum 1 turns of wire at connection. Fill anode recess connection with electrical potting compound. Conductors shall be No. 12 AWG Type TW copper wire.
- F. Connectors shall be Cadwel Thermite brazing type elements for mechanically bonding conductors to steel pipe. Moisture proof all connections to piping. Splices shall be made with split bolt compression connectors and suitable protection tape.
- G. For pipe installed in sleeves, provide insulators, equal to Maloney Model 57, spaced 10feet on centers, installed in accordance with manufacturer's recommendations. Provide insulating coupling for pipe penetrating building wall.
- H. Provide test stations housed in electrical conduit terminated in cast iron, waterproof junction boxes at ground surface. Embed in 12-inches x 12-inches x 6-inches concrete marker.

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 NFPA 54 Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INSTALLATION

- A. Install piping free from traps and with drain pocket consisting of nipple and cap at low points for inside building and drip pot for underground piping.
- B. Install shut-off valves at connection to each piece of equipment. Provide union or right and left nipple and coupling at equipment side of individual shut-off valve.
- C. Threaded Joints:
 - 1. Make-up joints with U.L. listed gas resistant Teflon tape or Teflon paste, suited for gas piping.
- D. Provide a two elbow-swing on all branches taken from a riser.
- E. Provide valve tags for piping systems indicating the operating system pressure.
- F. Color code piping at different pressures within the gas meter room. Paint fifteen (15) to five (5) psi system brown and reduced pressure piping yellow.
- G. Welders must be qualified in accordance with either API 1104 or A.S.M.E. IX Boiler and Pressure Vessel Code and as required by local code and ASW 31.1.

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- H. Provide sign on the exterior of the gas meter door shall be provided with bold lettering at least 1 in. high and properly spaced with lettering and background in contrasting colors reading "Gas Meter Room No Storage Permitted."
- I. Support horizontal gas piping as follows:
 - 1. $\frac{1}{2}$ in. 6 ft. on center.
 - 2. ³/₄ in. or 1 in. 8 ft. on center.
 - 3. 1¹/₄ in. or larger 10 ft. on center.
 - 4. Vertical piping at every floor.
- 3.4 OUTDOOR PIPING INSTALLATION
 - A. Comply with NFPA 54 Fuel Gas Code for installation and purging of natural-gas piping.
 - B. Install underground, natural-gas piping buried at least 24 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving for Building Slabs" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in ductile iron pipe containment conduit.
 - C. Install underground, PE, natural-gas piping according to ASTM D 2774.
 - D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
 - E. Copper Tubing with Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - F. Install fittings for changes in direction and branch connections.
 - G. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

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- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
- 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- H. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- J. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified here-in Division 22 Section "Meters and Gages for Plumbing Piping."

3.5 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 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.

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- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass type with polished chrome-plated finish.
 - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or splitcasting, cast-brass type with polished chrome-plated finish.
 - e. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Piping in Equipment Rooms: One-piece, cast-brass type.
 - g. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - h. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. 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 in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. 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.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. 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.
- R. Concealed Location Installations: Except as specified below, install concealed naturalgas piping and piping installed under the building in containment conduit constructed of

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steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

- 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
- 2. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
- 3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
- 4. 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, partitions and concrete slabs.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. 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.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainlesssteel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

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D. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for naturalgas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

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3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "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, 120 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 120 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 120 inches; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 120 inches; minimum rod size, 5/8 inch.
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.9 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.

3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

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- 3.11 PAINTING
 - A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
 - B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel semigloss.
 - d. Color: Gray.
 - C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. 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.
 - D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

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- 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Pressure Tests:
 - 1. Per local code.
 - 2. Test low pressure systems up to 0.5 PSIG with air at 3 PSIG for a minimum of one hour.
 - 3. Test medium pressure systems up to 3 PSIG with air at 100 PSIG for a minimum of four hours.
 - 4. Test high pressure systems 3 PSIG-15 PSIG with air at 100 PSIG for a minimum of four hours.
- D. Controlled Inspection:
 - 1. Perform radiography test on all welds in gas service and at gas meter and piping where operating pressures exceed 3 PSIG and where required by the local utility company or code. Radiography shall be performed in accordance with API 1104 or A.S.M.E. Section IX Boiler and Pressure Vessel Code and as required by local code.
- E. Purge all piping after pressure test and all appliances after piping has been purged.
- F. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 22 7000

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SECTION 23 00 10 - BASIC HVAC REQUIREMENTS

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. Mechanical systems, equipment, devices and accessories shall be installed, finished, tested and adjusted for continuous and proper operation. Any apparatus, material or device not shown on the Drawings but mentioned in these Specifications, or vice versa, or any incidental accessories necessary to make the project complete and operational in all respects, shall be provided. Include all materials, equipment, supervision, operation, methods and labor for the fabrication, installation, start-up and tests necessary for complete and properly functioning systems.

1.3 QUALITY ASSURANCE

- A. Code Compliance: Comply with all rules, laws, statutes, regulations, building codes, and the amendments of local, state and federal governments by the authorities having jurisdiction.
- B. ADA: Comply with the requirements of the Americans with Disabilities Act (ADA).
- C. HANDICAP ACCESS: Comply with Chapter 553, Part II, Florida Statutes, "ACCESSIBILITY BY HANDICAP PERSONS"; and the accessibility requirements manual from the Florida Board of Building Codes and Standards, Department of Community Affairs, latest Revisions.
- D. NFPA: Comply with the National Fire Codes compiled by the National Fire Protection Association.
- E. Florida Building Code: Conform in strict compliance to the current editions of Florida Building Code; Florida Mechanical Code; Florida Energy Efficiency Code, Florida Plumbing Code; Florida Fuel Gas Code; and the amendments to these codes which are enforced by the local authority having lawful jurisdiction.

1.4 DRAWINGS AND SPECIFICATIONS

A. Equipment Placement: The drawings are diagrammatic, intended to show general arrangement, capacity and location of various components, equipment and devices. Reasonable changes in locations ordered by the Engineer prior to the installation may be made at no additional cost.

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B. Drawing Scale: Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets, transitions and fittings may not be shown but shall be provided at no additional cost.

1.5 DEFINITIONS

- A. Concealed: When standing inside a finished room, insulated or non-insulated piping or ductwork not visible after installation, such as inside a chase or above a ceiling.
- B. Exposed: When standing inside a finished room, insulated piping or ductwork is visible after installation, such as inside an equipment room or an air handling unit room.
- C. Protected: The surface of insulated or non-insulated piping or ductwork on the exterior of the building but protected from direct exposure to the weather by an overhang, eave, in an unconditioned parking garage or building crawl space.
- D. Unprotected: The surface of insulated on non-insulated piping or ductwork on the exterior of the building and exposed to the weather.

1.6 SUBMITTALS

- A. Shop Drawings: Shop drawings include piping system layouts, ductwork layouts, fabrication and installation drawings of supports and anchorage for mechanical materials and equipment, and coordination drawings. Shop drawings also include proposed equipment layouts, drawn to scale, indicating that proposed equipment will fit into allotted space, including service access, connections, etc.
 - 1. Piping Systems: See Specification 232113 HYDRONIC PIPING. Submit shop drawings for piping systems drawn at a minimum scale of 3/8 inch per foot (1/4 inch per foot for mechanical rooms or congested areas) to verify clearances and equipment locations. Show required maintenance and operational clearances. Include the following:
 - **a.** Architectural and structural backgrounds with room names and numbers, including but not limited to plans, sections, elevations and details.
 - **b.** Fabrication and erection dimensions.
 - **c.** Arrangements and sectional views.
 - d. Details, including complete information for making connections to equipment.
 - e. Descriptive names of equipment.
 - f. Modifications and options to standard equipment required by Contract Documents.
 - 2. Ductwork: See Specification 233113 METAL DUCTS. Submit shop drawings for duct systems at a minimum scale of 3/8 inch per foot (1/4 inch per foot for mechanical rooms or congested areas) to verify clearances and equipment locations. Show required maintenance and operational clearances. Include the following:
 - **a.** Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
 - **b.** Fabrication and erection dimensions.
 - **c.** Arrangements and sectional views.

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- **d.** Details, including complete information for making connections to equipment.
- e. Materials and finishes.
- **f.** Descriptive names of equipment.
- g. Modifications and options to standard equipment required by Contract Documents.
- 3. Coordination Drawings: Submit coordination drawings including detailed drawings showing locations and positions of all Architectural, structural, electrical and mechanical elements. Drawings shall be minimum ¼ inch per foot for each mechanical equipment room, mechanical riser, or chase. All other areas shall be a minimum 1/8 inch per foot.
- B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements LEED V4 BD+C".
 - Product Data: Documentation for Leadership Extraction Practices in the following:
 a. Leadership Extraction Practices for Recycled Content
 - Leadership Extraction Practices for Recycled Content
 Product Data: Documentation for Low Emitting Materials
 - Product Data: Documentation for Low Emitting Materia a. Low Emitting Materials for Paints and Coatings
 - b. Low Emitting Materials for Adhesives and Sealants
 - <u>3.</u> Product Certificates: Provide the following:
 <u>a.</u> Environmental Product Declarations (EPD's)
 b. Corporate Sustainability Reporting (CSR's)
- B.C. Product Data: Product data includes the manufacturer's printed literature.
- <u>C.D.</u> Performance Data: Provide performance data, wiring and control diagrams.
- D.E. Installation Instructions: Installation instructions include detailed information, from the manufacturer, indicating specific installation requirements, instructions, and recommendations. Generic installation instructions are not acceptable. Instructions shall be the same as those included with the product when it is shipped from the factory.
- E.F. Written Operating Instructions: Operating instructions shall be the manufacturer's written operating instructions for the specified product. If the instructions cover more than one model or type of product they shall be clearly marked to identify the instructions that cover the product delivered to the project.
- F.G. Maintenance Instructions: Maintenance instructions shall be the manufacturer's printed instructions and parts lists for the equipment furnished. If the instructions cover more than one model or type of equipment they shall be marked to identify the instructions for the furnished product.
- G.<u>H.</u> Sustainable action submittals: Include Leadership extraction practices for ductwork and chilled water piping as well as Low Emitting Material components

1.7 INSTRUCTION TO THE OWNER

A. General: Instructions to the Owner shall be accomplished by representatives of the manufacturers involved. Allow time for complete coverage of all operating procedures. Provide field training in the design, operation and maintenance of the equipment and troubleshooting procedures. Explain the identification system, operational diagrams, emergency and alarm

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provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar provisions of the systems. On the date of substantial completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel.

- B. Training Period: Training period shall encompass a minimum of 12 hours of hands-on instructions with a maximum period of 4 hours per day. All training sessions will be recorded via video and turned over to GOAA for future reference. Refer to Sections 01 91 13 General Commissioning Requirements and 23 08 00 Commissioning of HVAC Systems
- C. Scheduling: Submit any remaining required items for checking at least one week before final inspection of the work. When submittal items are found acceptable, notify the Owner, in writing, that an "Instruction Conference" may proceed. Conference will be scheduled by the Owner. After the conference, copies of a memo certifying that the "Instruction Conference" and "Completed Demonstration" have been made will be signed by the Owner and the instructors, and one copy will be inserted in each submittal binder.
- 1.8 LIMITED COMMISSIONING RESPONSIBILITIES
 - A. See Specification Section 230800-Commissioning of HVAC Systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specified Products: Manufacturer's names and product model numbers indicated on the drawings and in these specifications establish the type, style, quality, performance, and sound rating of the desired product. Listing of other manufacturers indicates that their equivalent products would be acceptable if they meet the specification requirements, the specific use and installation shown on the drawings, including space and clearance requirements, and the energy consumption and efficiency of the specified product.
- B. Space Requirements: All manufactured products furnished on this project must have the required space and service areas indicated in the manufacturer's printed literature or shown on their approved shop drawings. When the manufacturer does not indicate the space required for servicing the equipment, the space shown on the drawings or as required by the Engineer must be provided.

2.2 MATERIAL AND EQUIPMENT

- A. General: Material and equipment used shall be produced by manufacturers regularly engaged in the production of similar items, and with a history of satisfactory use as judged by the Engineer.
- B. Specified Equipment: Equipment shall be the capacity and types indicated. Equipment and material furnished shall be the manufacturer's standard item of production unless specified or required to be modified to suit job conditions. Sizes, material, finish, dimensions and the

capacities for the specified application shall be published in catalogs for national distribution. Ratings and capacities shall be certified by a recognized rating bureau. Products shall be complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Aompatibility: Material and equipment of one and the same kind, type or classification and used for identical or similar purposes shall be made by the same manufacturer. Where more than one choice is available, select the options which are compatible with other products already selected. Compatibility is a basic general requirement of product selection.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. General: Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.
- B. Performance: Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship in the opinion of the Engineer, shall be removed and reinstalled.
- 3.2 CLEANING AND PROTECTION
 - A. General: Refer to Division 01 and to SMACNA IAQ Guidelines for Occupied Buildings Under Construction, 2007.
 - B. Housekeeping: Keep interiors of duct and pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping and ductwork at all times throughout the installation. Install 30% efficient filter media over each return air grille and open return duct opening; change media regularly during construction when dirty to keep duct interiors clean. Prevent dust, debris and foreign material from entering the piping and ductwork.
 - C. Equipment Protection: Protect fan motors, switches, equipment, fixtures, and other items from dirt, rubbish and foreign matter. Do not operate air handling equipment if the building is not clean or if dust can enter the coils or the fan housings.
 - D. Equipment Cleaning: Thoroughly clean equipment and entire piping systems internally upon completion of installation and immediately prior to Submittal Completion. Open dirt pockets and strainers, blow down each piping system and clean strainer screens of accumulated debris. Remove accumulated dirt, scale, oil and foreign substances. Thoroughly wipe clean internal surfaces of ductwork and air handling units prior substantial completion. Refer to Section 15060, Pipe and Fittings, for detailed requirements for piping systems' flushing and cleaning.
 - E. Filter Replacement: Provide filters, with the same efficiency rating as required for the final installation, for the protection of the air moving equipment and ductwork continuously throughout the construction phase. Filters shall have a minimum efficiency rating of MERV 8 in accordance with specification section 01 35 46. Provide a new set of clean filters matching

the efficiency and performance as specified for the final installation for the test and balance of the air side equipment.

F. Protection of Finished Installation: Where installation is required in areas previously finished by other trades, protect the area from marring, soiling or other damage.

3.3 CORRECTION OF WORK

- A. General: At no additional cost to the Owner, rectify discrepancies between the actual installation and Contract Documents when in the opinion of the Testing and Balancing Agency (T&B Agency) or the Engineer the discrepancies will affect system balance and performance.
- B. Shop drawing deviations need to be highlighted and noted on the submittal.
- C. Drive Changes: Include the cost of all pulley, belt, and drive changes, as well as balancing dampers, valves and fittings, and access panels to achieve proper system balance recommended by the T&B Agency.

3.4 COORDINATION AND ASSISTANCE

- A. General: Provide all labor, equipment, tools and material required to operate the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration and repair of all electric or pneumatic automated control devices and components. These services shall be available on each working day during the period of final testing and balancing.
- B. Drawings and Specifications: Provide to the T&B Agency a complete set of project record drawings and specifications and an approved copy of all HVAC shop drawings and equipment submittals. The T&B Agency shall be informed of all changes made to the system during construction, including applicable change orders.
- C. Coordination: Coordinate the work of all trades and equipment suppliers to complete the modifications recommended by the T&B Agency and accepted by the Engineer. T&B shall cut or drill holes for the insertion of air measuring devices as directed for test purposes; repair to as-new condition, inserting plastic caps or covers to prevent air leakage. Repair or replace insulation and re-establish the integrity of the vapor retardant.
- 3.5 PREPARATIONS FOR PERFORMANCE VERIFICATION
 - A. See Specification Section 230593 TESTING, ADJUSTING, AND BALANCING
 - B. Verification: Prior to commencement of balancing by the T&B Agency, verify the following in writing:
 - 1. Air filters have been replaced and are clean.
 - 2. Linkages between dampers and their actuators are secure, non-overloading and nonbinding.
 - 3. Ductwork specialties are in their normal operating positions.
 - 4. Fans are operating at the correct rotation and specified RPM.

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- 5. Ductwork has been pressure tested and accepted.
- 6. Strainers have been removed, cleaned and replaced, and that temporary construction strainers have been removed.
- 7. Compression or expansion tanks have been inspected, are not air-bound or waterlogged and are pre-charged, and that the piping systems have been completely vented and filled with water.
- 8. Air vents at coils and high points of the piping systems have been inspected and installed and operating freely.
- 9. Automatic valves, hand valves, and balancing valves have been placed in a fixed open position for full flow through all devices.
- 10. Linkages between valves and their actuators are secure, non-overloading and nonbinding.
- 11. Pressures for hydronic reducing valves have been set.
- 12. Operating temperatures have been set for chillers and regulating valves.
- 13. Pumps are operating at the correct rotation and specified horsepower.
- 14. Piping has been pressure tested and accepted and piping systems have been cleaned, flushed, sterilized and refilled with chemicals and prescribed treated water and vented.
- 15. Operating safety features (such as thermal overloads, firestats, freezestats, smoke detectors and relief valves), are installed and fully functional.
- 16. Equipment has been lubricated and can be operated without damage.
- 17. Systems are operational and complete.
- 18. No latent residual work remains to be completed.

3.6 LIMITED COMMISSIONING EXECUTION REQUIREMENTS

- A. TESTING PREPARATION
 - 1. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
 - 2. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
 - 3. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
 - 4. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
 - 5. Inspect and verify the position of each device and interlock identified on checklists.
 - 6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
 - 7. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the OAR/Engineer of Record.

B. TESTING AND BALANCING VERIFICATION

1. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the OAR/Engineer of Record.

- 2. Notify the OAR/Engineer of Record at least 10 days in advance of testing and balancing Work, and provide access for the OAR/Engineer of Record to witness testing and balancing Work.
- 3. The test and balance contractor shall provide an ultrasonic flow meter for test and balance verification of water systems. Mechanical subcontractor shall install pete's plug and balancing valves where they are needed but not shown on plans.
- 4. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the OAR/Engineer of Record.
 - **a.** The OAR/Engineer of Record will notify testing and balancing subcontractor, 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - **b.** The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - **c.** Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - **d.** Remedy the deficiency and notify the OAR/Engineer of Record so verification of failed portions can be performed.

C. GENERAL TESTING REQUIREMENTS

- 1. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the OAR/Engineer of Record.
- 2. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- 3. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- 4. The OAR/Engineer of Record along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- 5. Tests will be performed using design conditions whenever possible.
- 6. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the OAR/Engineer of Record and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- 7. The OAR/Engineer of Record may direct that set points be altered when simulating conditions is not practical.
- 8. The OAR/Engineer of Record may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

- 9. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- 10. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

D. HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- 1. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the OAR/Engineer of Record with preparation of testing plans.
- 2. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the OAR/Engineer of Record. Plan shall include the following:
- 3. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - **a.** Description of equipment for flushing operations.
 - **b.** Minimum flushing water velocity.
 - **c.** Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- 4. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

E. NON-CONFORMANCE

- 1. The OAR/Engineer of Record will record the results of the Performance Tests. All deficiencies, non-conformance issues, or test failures will be noted and reported to the Contractors in a deficiency list or in a punch-list format.
- 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the OAR/Engineer of Record. In such cases the deficiency and resolution will be documented on the procedure form.
- 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the OAR/Engineer of Record will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owners Representative.
- 4. Re-testing:

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- **a.** If a Performance Test fails, corrections shall be made to the deficient equipment or systems by the Contractors. The systems will be re-tested until they pass the Tests.
- **b.** The time/cost for the OAR/Engineer of Record to perform any re-testing required because of improper set up of the systems by the contractors or failed performance tests will be back-charged to the Contractor (who may choose to recover costs from the party responsible for executing faulty equipment start-up/checkout and associated checklists). This includes instances where a specific item was overlooked in the equipment start-up and checkout procedures, reported to have been successfully completed, but determined during Performance testing to be faulty.
- **c.** Any required re-testing by any contractor, sub-contractor, or vendor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- F. DEFICIENCIES AND RETESTING
 - 1. The OAR/Engineer of Record documents the results of each test. (Corrections of minor installation or sequence of operation deficiencies are made during tests at the discretion of OAR/Engineer of Record.)
 - 2. Deficiencies/non-conformance issues not corrected during testing are reported to the Contractors for corrective action. Upon completion, a request is made by the Contractors to OAR/Engineer of Record for retest.

3.7 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Requirements: Do not <u>install or</u> store fiberglass insulation or any equipment within the building until it has been "dried in". If dry space is unavailable and the insulation and equipment must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection. Protection must be continuously maintained until the building has been "dried in". Any insulation or equipment that becomes wet shall be removed and replaced.
- B. Replacement of Damaged Stored Material and Equipment: Any material and equipment that has been wet or otherwise damaged prior to, or after, installation shall be replaced with new material regardless of the condition of the material and equipment at the time of installation.
- C. Repair <u>or replacement</u> of Damaged Installed Material and Equipment: After installation correct or repair dents, scratches and other visible blemishes. At the direction of Engineer replace or repair to "as new" condition equipment which has been <u>wet or</u> damaged during construction. <u>Evidence of moisture damage includes, but is not limited to, corrosion (including "white rust"</u> on galvanized surfaces), biological growth or odors.
- 3.8 COORDINATION OF SERVICES
 - A. Interruption of existing services: Provide shutoff valves at points of interconnection to minimize downtime.

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3.9 LAYOUT OF EXISTING EQUIPMENT

A. The existing installation and all layouts are shown for reference only. Unforeseen conditions probably exist and existing and new work may not be field located exactly as shown on the drawings. Verify existing conditions in the field and notify the Engineer of any deviations required to install the work as shown. Coordinate new work with existing equipment, including removing, relocating, rerouting, extending with new materials, and reinstall existing piping, ductwork, conduits, wiring, tubing, supports and other equipment. The Engineer shall make the final decision on all deviations or modifications required by the existing conditions.

3.10 OWNERSHIP OF REMOVED EQUIPMENT

A. Construction materials and items of mechanical and electrical equipment which are removed and not reused shall be removed from the jobsite unless indicated as to be retained for the Owner. Include rigging, removal and hauling cost, as well as any salvage value, in the contract.

3.11 INTERRUPTION OF EXISTING BUILDING SERVICES

A. Interruptions to existing services shall be scheduled with the owner and shall not be made without the prior written consent of the owner's representative and proper coordination with other trades. Pre-work shall be performed to make the shutdown period as brief as possible.

END OF SECTION 23 00 10
SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Requirements, Supplementary Conditions, Division 01, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.
- B. Basic Requirements: Provisions of Section 23 00 10, Basic HVAC Requirements are part of this Section.
- C. Commissioning Requirements: Provisions of Sections 01 91 13 General Commissioning Requirements, 01 91 15 Facility Exterior Enclosure Commissioning are part of this Section.

1.2 SUMMARY

- A. This Section includes and applies to all work included in Division 23.
- B. Work in this Section includes providing labor, materials, equipment, services necessary, fabrication, installation and testing for fully operational and safe systems including all necessary materials, appurtenances and features whether specified or shown in the contract documents or not, in conformity with all applicable codes and authorities having jurisdiction for the following:
 - 1. Mechanical work covered by all sections within Division 23 of the specifications, including, but not limited to:
 - a. Heating, ventilating and air conditioning systems and equipment and accessories.
 - b. Piping materials and installation instructions common to most piping systems.
 - c. Equipment installation requirements common to equipment sections.
 - d. Motors and controllers, including variable frequency drives.
 - e. Control systems.
 - f. Testing and balancing.
 - g. Cleaning of piping systems.
 - h. Cleaning of ductwork, casings, plenums, etc.
 - i. Transition fittings.
 - j. Dielectric fittings.
 - k. Mechanical sleeve seals.
 - I. Escutcheons.
 - m. Grout.

- n. Equipment installation requirements common to equipment sections.
- o. Painting and finishing.
- p. Concrete bases.
- q. Supports and anchorages.
- r. Commissioning.
- s. Access Doors and Frames.
- t. Vibration and Sound Control.
- C. Provide cutting and patching, for the Mechanical Work.
- D. Provide piping from plumbing terminations, 10 feet from equipment, for water, gas, compressed air and as indicated.
- E. Provide drainage from noted equipment to floor drains, roof drains, sink, or funnel drains.
- F. Provide piping connections to equipment, as required, for kitchens and as indicated.
- G. Division 23 Contractors shall be responsible to carry out the commissioning requirements as specified in Section 230800 Commissioning of HVAC.
- H. It is the responsibility of each individual trade to provide access doors and frames of the appropriate size and locations to allow access to their respective equipment, valves, dampers, pull boxes, etc.

1.3 DEFINITIONS

- A. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.
- B. "Wiring": raceway, fittings, wire, boxes and related items.
- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings, in chases, in enclosures, in trenches or in crawl spaces.
- G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

- H. "Indicated," "Shown" or "Noted": as indicated, shown or noted on drawings or specifications.
- I. "Motor Controllers": manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
- J. "Control" or "Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.4 ABBREVIATIONS

- A. The following are industry abbreviations for plastic materials.
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- B. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

C.	Following is	a list of	abbreviations	and sy	vmbols that	are used	in the s	pecifications:
•					,			

Word or Symbol	Abbreviation or Symbol Used in Specifications	
φ	phase	
air conditioning unit	ACU	
alternating current	AC	
ampere	amp	
brake horsepower (bhp)	BHP	
British thermal units	Btu	
Celsius	С	
Cubic feet per hour	CFH	
cubic feet per minute	cfm	
cubic feet per second	cfs	
degree	0	
direct current	DC	
emergency power system	EPS	
etcetera (etc.)	etc.	
Fahrenheit	F	
feet	ft.	
feet per minute	fpm	
gallon	gal.	
gallons per minute	gpm	

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Word or Symbol	Abbreviation or Symbol Used in Specifications		
hertz	Hz		
horsepower	hp		
inches	in.		
kilovolt	kV		
kilowatt	kW		
KVA	kVA		
length	length		
manufacturer	Mfr.		
minute	minute		
number	No.		
ounce	OZ.		
percent	%		
plus and minus	±		
pound or pounds	lb. or lbs.		
pounds per square inch (psi)	psi		
power factor	pf		
psig	psig		
PVC	PVC		
revolutions per minute (rpm)	rpm		
square foot or square feet	sq. ft.		
times	times (unless used in an equation, then use x)		
uninterruptible power supply (UPS)	UPS		
Variable Frequency Drive	VFD		
volt	V		
water gauge	w.g.		
width	width		
wire-gauge	awg		

1.5 UTILITY CONNECTIONS

- A. Arrange for and pay utility costs for work of this Division.
- B. Included:
 - 1. Connection to utility company mains.
 - 2. Connection to on-site piping mains.
 - 3. Payment of service charges.
 - 4. Provisions for temporary utilities.
 - 5. Others as required.

1.6 JOB CONDITIONS

- A. Examine all drawings and specifications in a manner to be fully cognizant of all work required under this Division.
- B. Adjoining work of other Divisions shall be examined for interferences and conditions affecting this Division.
- C. Examine site related work and surfaces before starting work of any Section.
 - 1. Report to Architect, in writing, conditions which will prevent proper provision of this work.
 - 2. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.
 - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
- D. Connections to existing work.
 - 1. Verification of existing:
 - a. Before submitting bid, become thoroughly familiar with actual existing conditions and systems at the building, and of the existing installations to which connections must be made, including any necessary alterations, and existing building engineering practices and requirements. The intent of the work is shown on the drawings and described herein, and no consideration will be granted by reason of lack of familiarity on the part of the contractor with actual physical conditions, requirements, and practices at the site.
 - 2. Install new work and connect to existing work with minimum interference to existing facilities.
 - 3. Temporary shutdowns of existing services:
 - a. At no additional charges.
 - b. At times not to interfere with normal operation of existing facilities.
 - c. Only with written consent of Owner.
 - 4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
 - 5. Restore existing disturbed work to original condition.
- E. Removal and relocation of existing work.
 - 1. Disconnect, remove or relocate material, equipment, plumbing fixtures, piping and other work noted and required by removal or changes in existing construction.
 - 2. Where existing pipes, conduits and/or ducts which are to remain prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts.
 - 3. Provide new material and equipment required for relocated equipment.

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- 4. Plug or cap active piping or ductwork behind or below finish.
- 5. Do not leave long dead-end branches. Cap or plug as close as possible to active line.
- 6. Remove unused piping, ductwork and material.
- 7. Dispose of removed fixtures and equipment as directed.
- 8. Turn over removed fixtures and equipment to Owner as directed.
- F. Special Traffic Requirements:
 - 1. Maintain emergency and service entrances useable to pedestrian, truck, and ambulance traffic at all times.
 - 2. Where trenches are cut, provide adequate bridging for above mentioned traffic.
 - 3. (Other paragraphs as required).

1.7 CLEARANCE FROM ELECTRICAL EQUIPMENT

- A. Piping or ductwork:
 - 1. Prohibited in:
 - a. Electric rooms and closets.
 - b. Telephone rooms and closets.
 - c. Elevator machine rooms.
 - d. Electric switchboard room.
 - e. IDF and MDF Rooms
 - 2. Prohibited above an area within 5 ft. of:
 - a. Transformers.
 - b. Motor control centers.
 - c. Standby power plant.
 - d. Bus ducts.

1.8 SUBMITTALS

- A. Product Data: Product data includes the manufacturer's printed literature. <u>ALL</u> equipment, material, product and performance data shall be <u>CLEARLY</u> marked to specifically identify the item(s) being submitted for inclusion in this project. Non-pertinent data shall be deleted or marked through. Any and all deviations from the requirements of the Contract Documents shall be specifically listed, and clearly shown in the submittal. Any deviations not specifically disclosed in the submittal shall be solely at the risk of the Contractor, and shall be subject to discovery at any time. Any undisclosed deviations shall be corrected by the Contractor to comply with the requirements of the Contract Documents at no additional cost to the Owner, regardless of the acceptance of the submittal by the Architect/Engineer.
- B. Submit the following items as hereinafter specified:

- 1. Names and qualifications of test and balance agencies.
- 2. Layout Drawings.
- 3. Coordinated Drawings.
- 4. As-built Record Drawings (Submitted to Owner).
- 5. Record Files (Submitted to Owner).
- 6. Operating and Maintenance Manuals.
- 7. Welding certificates.
- 8. Equipment and material submittals as required by sections within this division.
- C. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements – LEED V4 BD+C".
 - 1. Product Data: Documentation for Leadership Extraction Practices in the following:

a. Regional/Local Multiplier Compliance

b. Extended Producer Responsibility

e.a.Leadership Extraction Practices for Recycled Content

- 2. Product Data: Documentation for Low Emitting Materials
 - a. Low Emitting Materials for Paints and Coatings
 - b. Low Emitting Materials for Adhesives and Sealants
- 3. Product Certificates: Provide the following:
 - a. Environmental Product Declarations (EPD's)
 - b. Corporate Sustainability Reporting (CSR's)

c. Health Product Declarations (HPD's)

- D. Items shall comply with the requirements as hereinafter specified.
- E. Submit shop drawings, product data, samples and certificates of compliance required by contract documents.
 - 1. See Division 1, Submittals for reference of minimum requirements, if not stated hereinbelow.
- F. Schedule of submittals, as agreed to by the Engineer, will set the basis of the minimum required submittals. Submittals shall be provided by the Contractor promptly and in accordance with the Schedule of submittals and in such sequence as to cause no delay in work or in work of any other divisions.
- G. Resubmission Requirements:
 - 1. In addition to Division 1 requirements, make any corrections or change in Submittals required. Resubmit for review until no exceptions are taken or a resubmission is not required.
 - 2. Shop Drawings and Product Data:
 - a. Revise initial drawings or data, and resubmit as specified for initial submittal.
 - b. Indicate any changes which have been made other than those requested.
 - 3. Samples: Submit new samples as required for initial submittal.

- 4. Clearly identify resubmittal by original submittal date, number and revision number and indicate all changes from previous submittal.
- 5. If more than two submissions are required (initial submittal and one resubmittal) based on rejection or lack of compliance by submittal, then the Contractor shall:
 - a. Arrange for additional reviews by the Design Engineers.
 - b. Pay all costs for such additional reviews.
- H. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:
 - 1. Confirming and correlating all quantities and dimensions.
 - 2. Selecting fabrication processes and techniques of construction.
 - 3. Coordinating their work with that of all other trades.
 - 4. Performing their work in a safe and satisfactory manner.
- I. Substitutions:
 - 1. See Division 1, Substitution Procedures.
- J. Layout (Shop) Drawings:
 - 1. Submit Layout Drawings indicating work within mechanical rooms, areas containing boilers, chillers, cooling towers, air handlers or pumps, areas containing acoustically lined ductwork, food service areas and for any areas. See Division 1 specification sections for additional requirements on layout drawings.
 - 2. Layout Drawings for mechanical rooms shall be at a scale of 3/81/4"=1'-0".
 - 3. Prepare 3-D models for all mechanical rooms, boiler room and chiller room.
 - 4. Prepare layout shop drawings for all areas.
 - 5. From the layout drawings, prepare and submit Coordinated Drawings as herein specified below.
- K. Coordinated Drawings:
 - 1. This Contractor shall prepare coordinated drawings which shall show work of all trades including, but not limited to:
 - a. Items noted in the Supplemental General conditions.
 - b. Coordinated Ductwork with penetrations at floors, walls, ceiling and roof.
 - c. Piping, including:
 - 1) HVAC, plumbing and fire protection.
 - 2) Minor Piping such as drains, air vents, condensate piping, etc.
 - 3) Sleeves and penetrations.
 - 4) Expansion devices, anchors, guides and hangers.
 - d. Mechanical Equipment.
 - e. Supports and suspension devices.

- f. Ductwork/Piping high points and low points.
- g. Electrical Equipment.
- h. Main Electrical conduits and bus ducts.
- i. Equipment support and suspension devices including hangers, supports and bracing.
- j. Structural and architectural constraints including:
 - 1) Beams, braces, trusses, flanges, constraints, walls, openings ratings, doors, wall types, glazing.
- k. Show location of:
 - 1) Valves.
 - 2) Chemical Treatment.
 - 3) Piping specialties.
 - 4) Dampers.
 - 5) Access doors.
 - 6) Control and electrical panels.
 - 7) Disconnect switches
 - 8) Others as required.
- 2. Drawings shall indicate coordination with work in other Divisions which must be incorporated in mechanical spaces, including, but not limited to:
 - a. Irrigation equipment and piping.
 - b. Elevator equipment.
 - c. Cable trays not furnished under Division 26.
 - d. Computer equipment.
 - e. Others as required.
- 3. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with routed duct mains, areas with routed piping mains, and areas adjacent to the existing structure.
- 4. Preparation of drawings:
 - a. Prepare reproducible CADD drawings.
 - b. Provide 3D model for the engineer's review (Revit, Navisworks, BIM 360 Glue)
 - c. Submit to other trades for review of space allocated to all trades.
 - d. Revise drawings to compensate for requirements of conditions created by other trades.
- 5. Final prepared drawings shall show that other trades affected have made reviews and signed, by each trade, at completion of coordination.
- 6. Coordinated shop drawings shall be for all areas.
- 7. Contractor is to assure that each trade has coordinated work with other trades, prior to submittal.
- L. As-built (Record) Drawings:

Provide after installation is complete. Final signoff and Owner acceptance will not occur prior to submission of As-built drawings to Owner.

- 1. Indicate as-built conditions and all revisions that occurred subsequent to "Coordinated Drawings" submittal, fully illustrating all revisions made by all trades in the course of work.
- 2. Dimension physical locations of ductwork, and piping with reference elevations and distances above finished floors, below beams, from wall faces, underground (invert elevations) and from column lines.
- 3. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents, piping drains and isolators.
- 4. Indicate all equipment sizes and capacities and tag numbers.
- 5. Provide drawing on reproducible mylar, CADD.
- 6. Provide 3D model for the engineer's review (Revit, Navisworks, BIM 360 Glue)
- 7. These drawings shall be for as-built record purposes for the Owner's use and are not considered shop drawings.
- M. Record Files:
 - 1. Provide 5 (five) electronic file copies of the As-built CADD drawings in the media (CDROM, Disks, Tape, etc.) of Owner's choice.
 - 2. Provide 3D model (Revit, Navisworks, BIM 360 Glue) in the owner's choice.
 - 3. Include hard copy and electronic copy of file naming convention, layering standards, drawing index and file descriptions.
 - 4. Electronic files shall be modifiable and shall include all associated referenced background files.
- N. Operating Instructions, Maintenance Manuals and Parts Lists:
 - 1. Before requesting acceptance of work, submit one set for review by Architect.
 - 2. After review, furnish five printed and bound sets.
 - 3. Include:
 - a. Manufacturer's name, model number, service manual, spare-parts list, and descriptive literature for all components, cross referenced and numbered on Record Drawings as required.
 - b. Maintenance instructions.
 - c. Listing of possible breakdown and repairs.
 - d. Instruction for starting, operation and programming.
 - e. Detailed and simplified one line, color coded flow and wiring diagram.
 - f. Field test report, including:
 - g. Instrument set points.
 - h. Normal operating valves.
 - i. Name, address and phone number of contractors equipment suppliers and service agencies.
 - j. Assemble manufacturer's equipment manuals in chronological order, following the specification alpha-numeric system, in heavy duty 3-ring binders clearly titled on the spine and front cover with appropriate index dividers.
- O. Quantity of Submittals Required:
 - 1. Layout (Shop) Drawings and Coordinated Drawings:

- a. Submit two prints and an electronic copy. Coordinate with project manager.
- b. Upon review, the electronic copy will be annotated and returned. Prints will be retained by the Engineer.
- c. Copies of these prints and the electronic copy will serve as record copies for Architect.
- 2. Product Data (brochures):
 - a. Submit two copies of product data and an electronic copy. Coordinate with project manager.
 - b. Upon review, the electronic copy will be annotated and returned.
 - c. If comments are required, they will be returned with each copy.
 - d. One copy will be retained by the Engineer.

1.9 RELATED WORK AND REQUIREMENTS

- A. Requirements of General Conditions and Division No.1 apply to all work in this division.
- B. Carefully check the documents of each section with those of other sections and Divisions. Ascertain the requirements of any interfacing materials or equipment being furnished and/or installed by those sections and Divisions, and provide the proper installation and/or required interface.
- C. As a minimum requirement and condition, the Contractor shall provide REVIT generated drawings (for the purpose of Layout Drawings, Coordinated Drawings, As-built Drawings and Record Drawings) with a proven layering standard. Deviation from this requirement shall be:
 - 1. At the sole discretion of the Engineer.
 - 2. Submitted as a substitution within the specified time frame.
- D. Related work specified elsewhere:
 - 1. Providing temporary heat.
 - 2. Providing finish painting.

<u>2.3.</u>

- 3.4. Access doors.
- 4.5. Trench covers and frames.
- 5.6. Providing chimney cleanout door and thimble.
- 6.7. Cutting and patching, except as noted in "AIA Document A201" and "Supplementary Conditions for Mechanical and Electrical Work.
- 7.8. Excavating and backfilling under building.
- 8.9. Excavating and backfilling.
- 9.10. Louvers in doors.
- <u>10.11.</u> Undercut doors.
- <u>11.12.</u> Wall louvers and screens.
- <u>12.13.</u> Plenums other than sheet metal.
- 13.14. Flashing.
- <u>14.15.</u> Shaft gratings.
- <u>15.16.</u> Equipment platforms.

<u>16.17.</u> Pipe heat tracing system.

1.10 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards and with all applicable national, state and local codes.
- D. All items of a given type shall be the products of the same manufacturer.
- E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 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.
- G. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements. All costs of any required changes, including redesign requirements, shall be the responsibility of the contractor.

1.11 REFERENCE STANDARDS

- A. Published codes, specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Division where cited below:
 - 1. AABC: Associated Air Balance Council.
 - 2. ADC: Air Diffuser Council.
 - 3. AMCA: Air Moving and Conditioning Association.
 - 4. ANSI: American National Standards Institute.
 - 5. ARI: Air-Conditioning and Refrigeration Institute.
 - 6. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
 - 7. ASME: American Society of Mechanical Engineers.
 - 8. ASSE: American Society of Sanitary Engineers.
 - 9. ASTM: American Society for Testing and Materials.
 - 10. AWS: American Welding Standards.

- 11. FM: Factory Mutual.
- 12. Local Utility Authorities.
- 13. National, State and Local Codes of all authorities having jurisdiction.
- 14. NEMA: National Electrical Manufacturer's Association.
- 15. NFPA: National Fire Protection Association.
- 16. OSHA: Occupational Safety and Health Act.
- 17. PDI: Plumbing and Drainage Institute.
- 18. State Energy Code having jurisdiction
- 19. FBC: Florida Building Code.
- 20. UL: Underwriters' Laboratories, Inc.
- 21. FMC: Florida Mechanical Code.
- 22. FPC: Florida Plumbing Code.
- B. In addition to complying with all other legal requirements, comply with current provisions of governing codes and regulations in effect during progress of the Work, and with the following:
 - 1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
 - 2. Where requirements between governing Codes and Regulations vary, the more restrictive provisions shall apply.
 - 3. Nothing contained in Contract Documents shall be construed as authority or permission to disregard or violate legal requirements. The Contractor shall immediately draw the attention of the Architect to any such conflicts noted in the Contract Documents.

1.12 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

1.13 SPECIAL TOOLS

- A. Furnish to Owner at completion of work:
 - 1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
 - 2. "Special tools": those not normally found in possession of mechanics or maintenance personnel.
 - 3. One pressure grease gun for each type of grease required.

- a. With adapters to fit all lubricating fittings on equipment.
- b. Include lubricant for lubricated plug valves.
- 4. Tag each item and cross reference in Maintenance Manual.
- 5. Turn over to Owner's representative or temporarily secure to unit at Architect's instruction.

1.14 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 plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Check dimensions of access route through the site from delivery point to final location. Where necessary, ship in crated sections of size to permit passing through available space. Dismantle and/or reassemble, reprovision and retest equipment too large to pass through available access route to final location in one piece.
- D. Ship equipment in original packages, to prevent damaging or entrance of foreign matter.
- E. Handle and ship in accordance with manufacturer's recommendations.
- F. Provide protective coverings during construction.
- G. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by Architect.
- H. Tag all items with weatherproof tag, identifying equipment by name and purchase order number.
- I. Include packing and shipping lists.
- J. Special requirements as specified in individual sections.

1.15 PROTECTION OF MATERIALS

- A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.
- B. Provide temporary storage facilities for material and equipment.
- C. Arrange with Owner for storage facilities for materials and equipment.

- D. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
 - 1. Remove from site and provide new, duplicate, material equipment or apparatus in replacement of that rejected.
- E. Cover motors and other moving machinery to protect from dirt and water during construction.
- F. Protect premises and work of other Divisions from damage arising out of installation of work of this Division.
 - 1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged as result of installation of work of this Division.
 - 2. Remove replaced parts from premises.
- 1.16 REVIEW OF CONSTRUCTION
 - A. Work may be reviewed at any time by representatives of Architect.
 - B. Advise Architect in writing that work is ready for review at following times:
 - 1. Prior to backfilling buried work.
 - 2. Prior to concealment of work in walls and above ceilings.
 - 3. When all requirements of Contract have been completed.
 - C. Neither backfill nor conceal work without Architect's consent.
- 1.17 SCHEDULE OF WORK
 - A. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
 - <u>B.</u> In scheduling, anticipate means of installing equipment through available openings in structure.
 - B.C. All equipment and materials shall be protected from damages, exposure to moisture and weather from the time of delivery to job site until date of substantial completion.
 - G.D. Confirm in writing to Architect, within 30 days of signing of contract, anticipated number of days required to perform test, balance, and acceptance testing of mechanical systems:
 - 1. This phase must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
 - 2. Submit for approval at this time, names and qualifications of test and balancing agencies to be used.

1.18 NOISE REDUCTION

- A. Cooperate in reducing objectionable noise or vibration caused by mechanical systems.
 - 1. To extent of adjustments to specified and installed equipment and appurtenances.
- B. Correct noise problems caused by failure to install work in accordance with Contract Documents. Include labor and materials required as result of such failure.
- 1.19 PERMITS, LICENSES, AND INSPECTIONS
 - A. Permits and Licenses:
 - 1. Secure required permits and licenses including payments of all charges and fees.
 - B. Inspections:
 - 1. Obtain certificates of final inspection approval from authorities having jurisdiction, and submit to Architect before acceptance of the Work.
 - 2. Obtain inspections during the Work as required to allow timely progress of these and other trades.

1.20 GUARANTEE

- A. Guarantee all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion, unless extended guarantee periods are specified in individual sections.
- B. Furnish guarantee covering all work in accordance with general requirements of the Contract.
- C. Provide new materials, equipment, apparatus and labor to replace that determined by Architect to be defective or faulty.
- D. This guarantee also applies to services such as Instructions, Adjusting, Testing, Noise, Balancing, etc.
- E. Equipment manufacturers shall include extended warranty to give full coverage during warranty period, unless longer period is specified.

1.21 PRELIMINARY OPERATION

A. Any portion of the system or equipment shall be placed in operation at the request of the Owner prior to the final completion and acceptance of the work. Such operation shall be under the direct supervision of the Contractor.

B. Preliminary operation thereof shall not be construed as acceptance of any part of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Division 23 Sections where articles and subparagraphs introduce lists, the following requirements apply for product selection:
 - 1. Contractor's Options:
 - a. For products specified only by reference standard, select product meeting that standard, by any manufacturer.
 - b. For products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
 - c. For products specified by naming one product or manufacturer, use that product or manufacturer only.
 - d. Wherever catalog numbers and specific brands or trade names are used, they are used to establish standards of quality, utility and appearance required.
- B. Submission of equipment of manufacturers' other than those specified shall detail equality and difference, item by item.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.3 ACCESS DOORS

- A. Size for proper access, adjusting and maintenance:
 - 1. 12 in. x 12 in. minimum for valves, trap primers, shock absorbers, etc.
 - 2. 24 in. x 24 in. for man access to concealed fans, coils, etc., unless indicated otherwise.
- B. Supply as required by work in this Division.

- C. Turn over for setting under trade installing surface on which panels are installed. Direct location and setting, after review by architect.
- D. Manufacturers:
 - 1. Access doors:
 - a. See Division 8
- E. Locate and set after review.
- F. Doors, except as noted, flush type with:
 - 1. No. 13 USSG steel door and trim.
 - 2. No. 16 USSG steel frame.
 - 3. Metal wings for keying into construction.
 - 4. Concealed hinges.
 - 5. Stainless steel cam lock, screwdriver operated.
 - 6. Similar to Karp Type DSC-214.
 - 7. Where door cannot swing open:
 - a. Lift off type.
 - b. With safety wire or chain.
 - c. Similar to Karp Type DSC-212.
- G. Doors, in acoustic tile ceilings:
 - 1. No. 13 USSG steel frame.
 - 2. No. 16 USSG steel pan-type door suitable for receiving tile thickness.
 - 3. Factory white finish.
 - 4. Stainless steel cam locks:
 - a. Screwdriver operated.
 - b. Finish flush with tile.
 - c. Minimum 2 per door.
 - 5. Hinges: not visible when door is closed.
 - 6. Tile filler: under General construction Work.
 - 7. Similar to Karp Type DSC-210.
- H. Doors recessed in plaster ceilings:
 - 1. With recess to receive plaster.
 - 2. Plaster fill: under General Construction Work.
 - 3. Similar to Karp DSC-210-PL.
- I. Doors in fire-rated construction:
 - 1. Insulated door panel and frame.

- a. Frame: 16 gauge steel.
- b. Panel: 20 gauge steel.
- c. 2 in. thick fire rated insulation.
- 2. Conform to requirements of regulating agencies.
- 3. Rating: UL 1 1/2 hour "B" label, 250°F rating.
- 4. Continuous hinge with stainless steel pin.
- 5. Automatic panel closer.
- 6. Interior latch release.
- 7. Finish:
 - a. Stainless steel.
 - b. With stainless steel trim for frame.
 - c. No. 4 satin finish.
- 8. Lock:
 - a. Self-latching.
 - b. Direct action knurled knob.
 - c. Flush screwdriver operated.
 - d. Key-operated cylinder lock with two keys.
 - e. Knurled knob and mortise cylinder. Cylinder replaceable with cylinder for master keying system.
 - f. Similar to Karp Type KRP-150 FR.
- J. Doors: Shop-painted 1 coat zinc chromate primer.

2.4 ACCESS TILE IDENTIFICATION

- A. Buttons, tabs, and markers: to identify location of concealed work.
- B. Submit for review.

2.5 MISCELLANEOUS METAL WORK

- A. Access Platforms:
 - 1. Under General Construction Work.
 - 2. Provide removable gratings, toeplates and guard rails: suitable for minimum 100 lb per sq.ft. floor loading.
 - 3. Supports:
 - a. Welded structural steel.
 - b. Cross-braced on 4 sides.
 - c. Welded to baseplates for anchor bolting to concrete piers.

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- 4. Provide access platforms for equipment, where indicated or required by authorities having jurisdiction. Submit shop drawings with details of construction and method of attachment.
- 5. In accordance with OSHA regulations.
- 6. Grating similar to:
 - a. Steel: Irving "X-Bar".
 - b. Aluminum: Irving "X-Bar".
 - c. Fiberglass: Ryerson Duradek I-5000.

B. Ladders:

- 1. Under General Construction Work.
- 2. Galvanized structural steel.
- 3. 18 in. wide.
- 4. 2 1/2 in. x 1/2 in. side rails.
- 5. 3/4 in. diameter rungs 12 in. on center.
- 6. In accordance with OSHA regulations.

C. Gratings in Shafts:

- 1. Under General Construction Work.
- 2. Suitable for minimum 100 lb per sq.ft. floor loading.
- 3. Support on structural steel members.
- 4. Submit shop drawings with details of construction and method of attachment.
- 5. Grating similar to:
 - a. Steel: Irving "X-Bar".
 - b. Aluminum: Irving "X-Bar".
 - c. Fiberglass: Ryerson Duradek I-5000.

D. Trench Covers, or Gratings and Frames:

- 1. Under General Construction Work.
- 2. Covers:
 - a. Galvanized checkered steel with:
 - b. Galvanized expanded and perforated steel with:
 - 1) Flush drop-type lift handles.
 - 2) Means for securing to frame for easy removal.
 - c. 3 ft. long.
 - d. 1/4 in. thick.
- 3. Gratings: steel similar to Irving Grating.
- 4. Frames: 2 in. x 2 in. x 1/4 in. galvanized welded angle iron with welded stops and lugs for anchoring into concrete.
- 5. Turn over for setting under General Construction work.

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E. Guards and Railings:

- 1. Furnish guards and railings as indicated and/or as required by Authorities having jurisdiction.
- 2. Provide OSHA approved guards for belt drives and rotating equipment.
- 3. Guards removable with:
 - a. Frames: No. 18 USSG steel.
 - b. Fronts: No. 20 USSG galvanized perforated steel with:
 - 1) Covered test openings to permit rpm readings without removal.
 - c. Supports: galvanized steel angles or channels, braced to maintain clearances of moving parts.
 - d. Clearance for motor adjustment.
 - 4. Railings: removable of 1¹/₄ in. pipe and rail fittings.

2.62.5 PAINTING

A. See Division 9, Painting

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. 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.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.

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- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. 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 chromeplated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - 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 or splitcasting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - 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 concealed or exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - I. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floorplate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

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- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsumboard partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughingin requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Grooved Joints: Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping

products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.3 PIPING CONNECTIONS

- A. 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 or grooved-joint couplings in piping NPS 2-1/2 and larger, adjacent to flanged or-grooved-ended valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Access to Valves and Equipment.
 - 1. Access shall be possible where valves, expansion joints, fire dampers, motors, filters, control devices, and any other equipment requiring access for servicing, repairs, or maintenance are located in walls, chases, and/or above ceilings.
 - 2. Definition of Accessible:
 - a. Valves and dampers may be operated.
 - b. Control devices may be adjusted.
 - c. Fire dampers may be reset.
 - d. Equipment access panels may be opened.
 - e. Normal maintenance work such as replacement of filters, lubrication of bearings, etc., may be performed readily within arm's reach of access opening.
 - f. It shall not be necessary to crawl through furred ceiling space to perform such operations.

- 3. Group concealed valves, expansion joints, controls, dampers and equipment requiring service access, so as to be freely accessible through access doors and to minimize the number of access doors required.
- 4. Relocate piping equipment and accessories as required, at no extra cost to afford proper maintenance access.
- 5. For access into ductwork see Section 233300: Air Duct Accessories.
- 6. Coordinate location of access panels with applicable trades installing walls or ceiling.
 - a. Coordinate panel locations with lights and other architectural features.
 - b. Submit proposed panel locations to Architect for review.
- 7. Access doors or panels will be installed by the trade furnishing surface on which panels are installed.
- 8. Arrange for location and marking of removable tiles in splined ceilings where access panels are not installed.

3.5 PAINTING

- A. All paint and coatings used within the waterproofing membrane must comply with the Low Emitting Pai9nt and Coatings testing criteria. Refer to Sections 01 35 46 and 01 81 13.14 for requirements.
- B. Painting of exposed roof-top equipment.
- C. Finish painting under Division 09 Sections "Interior Panting" and "Exterior Painting.".
 - 1. Colors coordinated by Mechanical Contractor as directed by Architect.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- E. Painting under this Division:
 - 1. Interior of ductwork as far back as visible from outside: flat black.
 - 2. Uncoated hangers, supports, rods and inserts: dip in zinc chromate primer.
 - 3. Factory prime coat for following except as noted.
 - a. Pumps.
 - b. Fans.
 - c. Motors.
 - d. Equipment.
 - e. Air outlets.
 - 4. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.
 - 5. Shop prime coat for following, except as noted:

- a. Structural frames.
- b. Platforms.
- c. Ladders.
- d. Railings.
- e. Tanks.

F. General:

- 1. Labor, materials and equipment necessary for field painting.
- 2. Protect flooring and equipment with drip cloths.
- 3. Paint and materials stored in location where directed.
- 4. Oily rags and waste removed from building every night.
- 5. Furnish each space containing stored painting materials with approved 2¹/₂ gallon fire extinguisher.
- 6. Wire brush and clean off all oil, dirt and grease areas to be painted before paint is applied.
- 7. Mixing:
 - a. Mixed and strained as required by manufacturer.
 - b. Use thinners only in accordance with manufacturer's recommendation.
 - c. Follow printed instructions on paint containers. If none are available, instructions shall be obtained in writing from manufacturer.
- 8. Workmanship:
 - a. No painting or finishing shall be done with:
 - 1) Dust laden air.
 - 2) Unsuitable weather conditions.
 - 3) Space temperature below 60°F.
 - b. Pipes being painted: containing no heat and to remain cold until paint is dried.
 - c. Paint spread: uniform and proper film thickness showing no runs, sags, crawls or other defects.
 - d. Finished surfaces shall be uniform in sheen, color, and texture.
 - e. All coats to be thoroughly dry before succeeding coats are applied, minimum 24 hrs. between coats.
 - f. Priming undercoat: slightly different color for inspection purposes.
- 9. Exposed, uninsulated, ungalvanized sheet metal other than stainless steel and aluminum: Two coats of aluminum paint or alkyd paint color as directed.
- 10. Exposed, uninsulated, galvanized sheet metal in finished space including mechanical equipment rooms:
 - a. One coat galvanized iron primer.
 - b. Two coats alkyd oil paint, color as directed.
- 11. Exposed, insulated piping and equipment covering:

- a. One coat primer sealer.
- b. Two coats alkyd oil paint, color as directed.
- 12. Finned tube radiation: One coat factory or field applied coat of heat resisting paint.
- 13. Paint following with two coats alkyd oil paint, color as directed:
 - a. Exposed steel and metal work not furnished with factory-painted finish.
 - b. Structural steel supports for piping ductwork and equipment.
 - c. Exposed, uninsulated piping.
- 14. Exposed, uninsulated aluminum sheet metal in finished space:
 - a. One coat zinc chromate primer.
- 15. No paint on exposed, uninsulated stainless steel sheet metal in finished space.
- G. Finish painting:
 - 1. Consisting of two finished coats of high gloss medium or long alkyd paint over prime coat.
 - 2. Submit color shade for approval.
 - 3. Piping continuously painted in all exposed areas.
 - 4. Color coding per Section 230553: Mechanical Identification for HVAC piping and equipment
- H. Interior of ductwork as far back as visible from outside: flat black.
- I. Uncoated hangers, supports, rods and inserts: dip in zinc chromate primer.
- J. Factory finish:
 - 1. Steel air outlets in acoustical tile ceilings: baked white enamel.
 - 2. Aluminum air outlets: anodized.
 - 3. Exposed fan coil units: baked enamel.
 - 4. Unit ventilators and unit heaters: baked enamel.
- K. Factory prime coat, except as noted:
 - 1. Pumps.
 - 2. Fans.
 - 3. Motors.
 - 4. Equipment.
 - 5. Registers.
 - 6. Diffusers.
 - 7. Grilles.
- L. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.
- M. Shop prime coat for following except as noted:

- 1. Structural frames.
- 2. Platforms.
- 3. Ladders.
- 4. Railings.
- 5. Tanks.

3.6 CONCRETE WORK

- A. On concrete floors, install equipment on concrete housekeeping pads:
 - 1. Pads 4 in. high unless otherwise noted.
 - 2. Extend 6 in. minimum beyond equipment base, all sides.
 - 3. Concrete work, including forming and reinforcing, under Division 03
 - a. Coordinate size and location with General Contractor.
 - b. Furnish and locate anchors and anchor bolts.
 - 4. Curbs for field erected plenums similar.
- B. Miscellaneous Concrete Items:
 - 1. Concrete work, including forming and reinforcing, under Division 03.
 - 2. Concrete for:
 - a. Anchor and thrust blocks.
 - b. Underground tank hold down slabs.
 - c. Pipe trenches.
 - 3. Refer to details on drawings.
- C. Provide foundations for:
 - 1. Pumps.
 - 2. Fans.
 - 3. Air handling units and floor mounted plenums
 - 4. Refrigeration equipment.
 - 5. Floor mounted control panels.
 - 6. Motors.
 - 7. As noted.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

- 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
- 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.
- 3.9 GROUTING
 - A. See requirements in Divisions 3 and 4.
- 3.10 EXCAVATION AND BACKFILL
 - A. Excavate, backfill and restore surfaces inside building.
 - B. Excavate, backfill and restore surfaces inside and outside building.
 - C. Excavate, backfill and restore surfaces to 5 ft. outside building.
 - D. Excavation:
 - 1. In accordance with requirements of Division 2.
 - 2. Minimum depth, unless otherwise indicated:
 - a. Metallic pipe: 24 in.
 - b. Non-metallic pipe: 30 in.
 - c. Below frost line.
 - 3. If rock encountered:
 - a. Excavate to 6 in. below bottom of piping.
 - b. Refill with well tamped sand and gravel.

- 4. Bank excavated materials adjacent to trench as directed.
- 5. Bank supports:
 - a. Sheet-piling, shoring or otherwise properly supported.
- 6. Install and maintain barricades, signs and lights.
- 7. Keep excavation free of water with attended pumping equipment.
- 8. No extra compensation:
 - a. For quicksand, hardpan, or other material encountered in excavating.
 - b. Except rock on unit price basis.
- 9. Remove bog or other swampy conditions encountered in excavating to 1 ft. below bottom of piping.
 - a. Backfill with well tamped sand, finely crushed stone or gravel.
- E. Installation of Underground Piping:
 - 1. On solid undisturbed ground.
 - a. Provide firm bed of sand for pipes with any form of protective covering.
 - 2. On concrete or brick piers or cradles:
 - a. Unsuitable ground, as directed.
 - b. Trench crossings.
 - c. Crossing excavation adjacent to building wall or foundations.
 - 3. Bottom of trenches:
 - a. Tamped hard.
 - b. Graded for required pitch.
 - c. Shaped to give uniform support to lower third of full length of pipe.
 - d. Recesses excavated for bells and joints.
 - 4. Support and protect piping so it remains in place without settling or damage during and from backfilling.
 - a. Replace damaged pipe.
 - 5. Under building:
 - a. Temporarily support from below during installation and construction.
 - b. Encase in concrete as detailed on Drawings.
 - c. Permanently support with U rod hangers.
 - 1) Ends bent over reinforcing bars in construction above.
 - 2) Rod materials:

- a) Everdur 651 Alloy.
- b) Double-dipped galvanized steel.
- 3) Minimum diameter of rods for following pipe sizes:

Up to 2 in.	3/8 in.		
2 ½ to 4 in.	½ in.		
5 and 6 in.	5/8 in.		
8 and 10 in.	¾ in.		
12 to 16 in.	7/8 in.		

- 4) Paint hangers with heavy coat of bitumen solution paint.Paint shall comply with the Low-Emitting Paint and Coatings criteria. Refer to Division 9.
- F. Backfilling:
 - 1. Immediately after piping installed, inspected, tested and accepted:
 - 2. Remove sheet piling and bracing.
 - 3. Backfill around piping with special care to solidly fill voids without damage to piping.
 - 4. Backfill material.
 - a. Clean loam, clay, sand, gravel or lightweight aggregate:
 - 1) Sand only up to 6 in. above top of piping with any form of protective covering.
 - 2) Remainder to be excavated earth free from frozen materials, lumps of clay, rocks, cinders, slag, ashes, organic materials, building or other debris, or refuse.
 - b. Install granular pipe insulation around pipe as specified in Section 230700: Piping Insulation.
 - 5. Backfill:
 - a. Up to 2 ft. above pipe, hand fill in 4 in. layers.
 - b. Remainder, fill in 6 in. layers.
 - c. Tamp and puddle each layer before placing next layer.
 - d. No stones larger than 2 in. diameter allowed in fill up to 2 ft. above piping.
 - e. No stones larger than 4 in. diameter allowed in fill above.
 - f. Backfill in manner to prevent future settlement, in accordance with Division 2.
 - g. Backfill to required compaction; per ASTM D-1557-587:
 - 1) 95% under building slabs.
 - 2) 90% outside of building.
- G. Restore existing surfaces disturbed or damaged by excavation and backfilling, including, but not limited to:

- 1. Turf.
- 2. Plants.
- 3. Concrete walks.
- 4. Asphaltic paving.
- 5. All other surface improvements.
- H. Dispose of acceptable surplus excavation on site as directed.
- I. Remove surplus and unsuitable excavated materials from site as directed.

3.11 CUTTING AND PATCHING

- A. All carpentry, cutting and patching to be done under trades doing that work.
- B. Provide all carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.
- C. Do not cut or drill structural members without consent of Architect.

3.12 CUTTING THROUGH CELLULAR FLOORING

- A. Cut openings for reception of work:
 - 1. In accordance with manufacturer's recommendations and approval.
 - 2. Not to interrupt continuity of electrical raceways.

3.13 WATER PROOFING

- A. Under General Construction Work.
- B. Where any work pierces waterproofing, installation shall be subject to review.
 - 1. Provide all necessary sleeves, caulking, flashing and flashing fittings required to make openings absolutely watertight.
- C. Flashing:
 - 1. 6 lb. lead.
 - 2. 16 oz. lead coated copper.
 - 3. No.22 USSG aluminum.
 - 4. Fittings for piping through roof:
 - a. Galvanized cast iron bottom recess roof type.
 - b. Similar to Josam No. 26440 or No. 26450.

- D. Provide weather protection canopies, hoods or enclosures over out-of-door equipment which could be damaged by exposure to weather.
 - 1. This requirement applies to:
 - a. Damper operators.
 - b. Damper bearings.
 - c. Controls.
 - d. Instruments.
 - 2. See other sections in this Division for application of this requirement to motors, drives, ducts, and fans, etc.
 - 3. Identify items under such covers if entirely enclosed.
- 3.14 CLEANING AND ADJUSTING
 - A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
 - B. Painted or exposed work soiled or damaged: clean and repair to match adjoining work before final acceptance.
 - C. Remove debris from inside and outside of materials and equipment.
 - D. Flush out piping after installation.
 - E. Clean piping systems as described in Division 23, Section Hydronic Piping.
 - F. Adjust valves and automatic control devices.
 - G. Traps, wastes and supplies: unobstructed.
- 3.15 FIELD QUALITY CONTROL
 - A. Tests:
 - 1. Perform as specified in individual sections, and as required by authorities having jurisdiction.
 - 2. Duration as noted.
 - B. Provide required labor, material, equipment, and connections.
 - C. Furnish written report and certification that tests have been satisfactorily completed.
 - D. Repair or replace defective work, as directed.
 - E. Pay for restoring or replacing damaged work due to tests, as directed.

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F. Pay for restoring or replacing damaged work of others, due to tests, as directed.

3.16 TRAINING

- A. Provide training by qualified manufacturers' representatives for equipment as specified in this Division.
- B. Training to include:
 - 1. Site-specific training. System operations, system maintenance, emergency processes (if any), warranty procedures and process, as well as what type of recording deliverable preferred. Refer to additional information included in 01 19 13 and 01 32 33.
 - 2. Minimum hours as specified in each Section.
 - 3. Training materials (minimum six sets).
 - 4. Video recordings (2 copies on USB keys) of each training session upon completion.
- C. Each training session to be scheduled with Owner at least 30 days in advance.

3.17 COMMISSIONING

A. Division 23 Contractors shall be responsible to carry out the commissioning requirements specified in the commissioning sections, and all other sections related to commissioning. Provide all necessary labor, materials, and coordination required for successful completion of the commissioning requirements. Refer to Specification Sections 01 91 13 General Commissioning Requirements.

3.18 ACCESS DOORS AND FRAMES

A. Provide access doors and frames of the appropriate size and locations to allow access to mechanical equipment, valves, dampers, etc. All locations are to be field verified with the Architect prior to installation.

3.19 INSTALLATION OF HVAC EQUIPMENT SUPPLIED BY OTHER DIVISIONS

- A. Division 23 Contractors shall be responsible to provide all necessary labor, materials, and coordination required for successful installation of equipment provided by other divisions but vital for successful operation of HVAC equipment. Equipment and materials vital for successful operation of HVAC equipment include but are not limited to the follow:
 - 1. Control Dampers
 - 2. Control Valves
 - 3. Thermowells
 - 4. Pipe Taps

- 5. Water Sensors and Switches
- B. Prior to performing testing and balancing work, provide copies of reports, sample forms checklists, and certificates to the OAR/ Engineer of Record.

END OF SECTION 23 05 00
SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.
- B. Basic Requirements: Provisions of Section 230010, BASIC HVAC REQUIREMENTS are part of this Section

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, generalpurpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 ELECTRIC MOTOR MANUFACTURERS:

- A. Manufacturers:
 - 1. General Electric Inc.
 - 2. Westinghouse Electric
 - 3. Baldor Electric Company

2.3 MOTOR CHARACTERISTICS

- A. Duty: Provide motors for continuous duty conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard load, high torque, or any other special type as required by the equipment motor manufacturer's recommendations. Unless otherwise indicated or required, motors shall be open dripproof type. Continuous duty at ambient temperature of 95 deg F and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Unless otherwise indicated or required, motors shall be open drip-proof type.
- D. Motors installed outdoors shall be totally enclosed fan cooled (TEFC) type.
- E. Motor enclosures shall be of the type recommended by the equipment manufacturer for the specific application.
- F. All motors shall be furnished for starting in accordance with the electric utility company's requirements and shall be compatible with the motor starter and driven load. Motors shall not exceed full-rated nameplate load when operated at any point along the driven equipment's characteristic performance curve. The motor service factor shall not be used to justify exceeding nameplate amperage.
- G. Unless otherwise indicated, motors 1/3 horsepower and less shall be single phase. Motors 1/2 horsepower and larger shall be 3 phase, squirrel-cage induction type.
- H. Sound power levels for motors shall be no greater than the guidelines recommended by NEMA MG 1-2007. A motor which generates excessive noise within an occupied area of the building shall be replaced with a quieter operating motor at no additional cost to the Owner.
- I. Verify the circuit voltage and phase being furnished to the motor. All motors shall be 1800 rpm unless noted otherwise. Motors shall operate with electrical input voltage variations of plus or minus 1 percent of nameplate rating or frequency variations of plus or minus 5 percent of nameplate rating.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1, including applications of premium efficiency motors.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

- 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- 5. Shaft Grounding System:
 - a. Motors 5 hp and greater shall have a single shaft grounding system to protect the bearings from capacitive discharge through the bearings. A shaft grounding system equal to that manufactured by Shaft Grounding Systems, Inc., CR Series, or approved equivalent shall be used.
 - b. The shaft grounding system shall reduce the shaft to frame voltage below 3 volts (as measured with 50 MHZ Fluke 97 oscilloscope), have low drag, be field installable with hand held tools, sealed to be resistant to weather and contaminants and require no periodic adjustments or maintenance for a normal running life of five to ten years at speed up to 1800 rpm. The grounding brush element must be changeable without shutting down or using special tools. Experience has shown that brush life may often be as long as ten years.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.6 ELECTRICALLY COMMUTATED (EC) MOTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ebm-papst
 - 2. Rosenberg
 - 3. Ziehl-Abegg
 - 4. Approved Equal
- B. Factory mounted, line-fed variable speed EC external-rotor motor with maintenance-free ball bearings and permanent lubrication.
- C. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
 - 4. Motors shall be permanently lubricated with heavy duty ball bearings to match the fan load and pre-wired to the specific voltage and phase.
 - 5. Motors shall include integrated electronic control board to convert AC power supplied to the fan to DC power to operate the motor with direct micro- processing control signaling for fan speed control, soft starting capabilities and integrated current limitations.
 - 6. Motor shall be speed controllable down to 20% of full speed (80% turndown).
- D. Motor shall be a minimum of 85% efficient at all speeds
- E. Wide voltage input:
 - 1. Single phase: 200-277V, 50/60 Hz respectively
 - 2. Three phase: 380-480V, 50/60 Hz respectively

- F. Robust mechanical design with IP 55 type of protection and insulation class "F".
- G. Die-cast aluminum closed and compact design with integrated electronics.
- H. Shaded-Pole Motors: Do not use, unless motors are smaller than 0.05 kW.
- I. Technical Features:
 - 1. Continuous operation
 - 2. PFC (passive)
 - 3. Integrated PID controller
 - 4. Control input 0-10VDC or 4-20 mA
 - 5. Input for sensor 0-10V or 4-20 mA
 - 6. Slave output 0-10V max. 5 mA
 - 7. 7. Output 20VDC (±25 % / -10%) max. 50 mA
 - 8. Output 10VDC (+3 %) max. 10 mA
 - 9. RS485 MODBUS
 - 10. Motor current limitation
 - 11. Short-circuit protection
 - 12. Alarm relay with zero-potential change-over contacts (250VAC/2A,cos ϕ = 1)
 - 13. Line undervoltage / phase failure detection
 - 14. Over-temperature protected electronics / motor
 - 15. Locked-rotor protection, soft start
 - 16. Digital inputs for day/night switch, enabling, cooling / heating
 - 17. EMC:
 - a. Interference emission acc.to EN 61000-6-3
 - b. Interference immunity acc.to EN 61000-6-2
 - c. Harmonics acc.to EN 61000-3-2/3
 - 18. Leakage current: < 3,5 mA acc.to EN 61800-5-1
 - 19. Connection leads: Via terminal box
 - 20. Protection class: I (acc.to EN 61800-5-1)
 - 21. Approvals: UL

2.7 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Single phase motors for hard starting applications including outdoor installations shall be capacitor start/induction run or capacitor start/capacitor run type designed for the application. Motors for fans and pumps located indoor may be split phase with permanently lubricated sealed ball bearings and shall be selected for quiet operation.

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Motors 1/8 horsepower and below may be shaded pole type with permanently sealed bearings.

- D. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- E. Motors 1/20 HP and Smaller: Shaded-pole type.
- F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.8 POWER FACTOR

- A. All equipment furnished utilizing a combined electrical load of greater than 1000 watts shall have a power factor of not less than 0.90 under rated load conditions.
 - 1. Where motors are not available with a minimum 0.90 power factor, provide motor mounted power factor correction capacitor to improve power factor to at least 0.90 under rated load condition.

2.9 MOTOR STARTERS

- A. Compliance: Motor starters included as an integral part of a factory pre-wired control panel shall be provided by the manufacturer of the equipment it serves and shall comply with the requirements of Division 26.
- B. Overload Protection: Unless otherwise indicated, all 3 phase motor starters shall be provided with thermal overload relays on each phase sized in accordance with the actual nameplate full load ampere rating. Single phase motors shall be furnished with built-in thermal protection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install material and equipment in accordance with details shown on the drawings, submittals drawings and manufacturer's instructions.
- 3.2 SCHEDULED HORSEPOWER
 - A. Nominal Size: The horsepower scheduled or specified are those nominal sizes estimated to be required by the equipment when operating at specified duties and efficiencies. In

the case of pumps and fans, these motors shall be non-overloading at any point of the performance curve.

- B. Minimum Size: Motor horsepower shall not be reduced from the scheduled size regardless of the requirements of the selected or submitted equipment.
- C. Increased Size: If the actual motor horsepower for the equipment furnished is larger than the scheduled size indicated, the proper size feeder, breaker, starter, etc. shall be provided at no additional cost to the Owner. Change in motor size shall be identified and brought up to the engineer's attention as part of the submittal.
- D. Vibration: Motor vibration in any direction as measured at the bearing housings, when tested in accordance with NEMA Standard MG 1, shall be within the following table:

	UNFILTERED VIBRATION LIMITS	
Speed, rpm	Rotational Fre-	Velocity, in/s peak
	quency, Hz	(mm/s)
3600	60	0.15 (3.8)
1800	30	0.15 (3.8)
1200	20	0.15 (3.8)
900	15	0.12 (3.0)
720	12	0.09 (2.3)
600	10	0.08 (2.0)

1. TABLE - VIBRATION LIMITS

2. If balance weights are added to the rotor, they shall be permanently secured by welding or riveting. Machine nuts, bolts and screws are prohibited.

3.3 WIRING

- A. Power: All power wiring including safety disconnect switches, motor starters, over-current protection, connection to equipment, etc. shall be installed according to the requirements of Division 26, ELECTRICAL.
- B. Interlock: Unless otherwise noted, all interlock wiring, such as remote line voltage thermostats, fan speed controllers, etc. shall be installed by the supplier of that equipment. Interlock wiring shall be installed according to the requirements of Division 26, ELECTRICAL.
- C. Control: All control wiring exposed in mechanical equipment rooms, fan rooms, return air plenums, etc. shall be in conduit. Low voltage control wiring may be installed without conduit in return air plenums provided the cable is plenum rated <u>and installed in an approved raceway system</u>. Control wiring freely run in concealed plenums is not acceptable for any applications on this project. and the installation is acceptable to the authority having jurisdiction.

3.4 WEATHER PROTECTION

- A. Wiring: All electrical wiring exposed to the weather or in damp locations shall be enclosed in weatherproof fittings as required in Division 26, ELECTRICAL.
- B. Enclosures: Enclosures for electrical equipment shall be NEMA 3R unless indicated otherwise.

END OF SECTION 23 05 13

SECTION 23 05 14 - VARIABLE FREQUENCY MOTOR CONTROLLERS

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 DESCRIPTION
 - A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.
 - B. The drive manufacturer shall supply the drive and all necessary options, specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years. All VFDs installed on this project shall be from the same manufacturer.
- 1.3 SUMMARY
 - A. Related Sections
 - 1. Section 237313 Modular Air-Handling Units
 - 2. Section 233423 HVAC Power Ventilators
 - 3. Section 232123 Hydronic Pumps
 - 4. Section 230900 Instrumentation and Control For HVAC
 - B. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- 1.4 REFERENCES
 - A. Institute of Electrical and Electronics Engineers
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - B. National Electrical Manufacturers Association
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 7 Industrial Control and Systems: Adjustable Speed Drives.
 - 4. NEMA ICS 7.1 Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
 - C. International Electrical Testing Association

1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- B. Product Data: For each type and rating of VFC indicated. Include the following features:
 - 1. Performance
 - 2. Electrical Ratings
 - 3. Operating Characteristics
 - 4. Dimensioned outline drawing
 - 5. Schematic diagram
 - 6. Component list
 - 7. Power and control connection diagram(s).
 - 8. Bacnet Interface Controller (BACnet MSTP)
 - 9. Compliance to IEEE 519 harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
 - a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. If Distortion is more than 5%, then an external Harmonic Mitigation Filter shall be provided by the Manufacturer. Testing shall be performed and certified in accordance with IEEE per Manufacturer or an independent certified Electrical Testing Laboratory specialized in these tests. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors.
- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturer's Field Reports: Indicate start-up inspection findings.
- E. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; indentify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD (V) at each VFC to specified levels. Testing shall be performed and certified in accordance with IEEE per Manufacturer or an independent certified Electrical Testing Laboratory specialized in these tests.
- F. Provide list of all "read only" integration points, functions and alarms available at the BMS via BACnet MSTP integration.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 Execution and closeout requirements.
- B. Provide final equipment submittal information with all noted corrections incorporated.
- C. Field quality-control reports
- D. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.
 - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip setting.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- E. Load Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motor to be protected.

1.7 QUALITY ASSURANCE

- A. Refer to calculation and additional testing requirements located within Division 26 and Part 3 of this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. QUALITY ASSURANCE
 - 1. Referenced Standards:
 - a. Institute of Electrical and Electronic Engineers (IEEE)
 - 1) Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - b. Underwriters laboratories
 - 1) UL508C
 - c. National Electrical Manufacturer's Association (NEMA)
 - 1) ICS 7.0, AC Adjustable Speed Drives
 - d. IEC 16800 Parts 1 and 2

- e. National Electric Code (NEC)
 - 1) NEC 430.120, Adjustable-Speed Drive Systems
- 2. Qualifications:
 - a. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Section 01 Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping and provide additional plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions:
 - 1. Ambient Temperature: Not less than 14 deg. F. and not exceeding 104 deg. F.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg. F. and not exceeding 140 deg. F.
 - 3. Humidity: Less than 95 percent (noncondensing).
 - 4. Altitude: Not Exceeding 1000 feet.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within the specified warranty period.
- B. Furnish five year manufacturer warranty for variable frequency controller, starting from the date of Substantial Completion-

1.11 TRAINING

A. Contractor shall provide 16 hours of training to <u>university facility</u> staff divided into 4 sessions.

- B. Training shall be video taped by a licensed videographer. One DVD copy shall be provided to the owner and one DVD copy shall be provided to the commissioning agent for issuance into the commissioning report.
- 1.12 MAINTENANCE SERVICE
 - A. Section 01 Execution and Closeout Requirements: Maintenance service.
 - B. Furnish service and maintenance of variable frequency controller for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 VARIABLE FREQUENCY CONTROLLER
 - 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. ABB.
 - 2. Danfoss Inc.; Danfoss Drives Division (Labeled Drives Manufactured by Danfoss Inc. also Permitted)
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. Yaskawa Electric America, Inc; Drives Division
- 2.2 VARIABLE FREQUENCY CONTROLLER
 - A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 - Environmental operating conditions: VFDs shall be capable of continuous operation at 0 to 500 C (32 to 1220 F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40° C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
 - B. All VFDs shall have the following standard features:
 - 1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - 2. VFDs shall be capable to operate with a minimum power factor of 0.95

- 3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
- 4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
- 5. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
- 6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.
- 7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
- 8. The VFD shall have the ability to automatically restart after an over-current, overvoltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
- 9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
- 10. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.
- 11. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.
- 12. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- 13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over

the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

- 14. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload
- 15. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
- 16. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
- 17. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
- C. All VFDs to have the following adjustments:
 - 1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
 - 2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
 - 3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
 - 4. Two (2) programmable analog inputs shall accept current or voltage signals.
 - 5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
 - 6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.
 - 7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A

at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

- 8. Run permissive circuit There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.
- 9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
- 10. Seven (7) programmable preset speeds.
- 11. Two independently adjustable accel and decel ramps with 1 1800 seconds adjustable time ramps.
- 12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
- 13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
- 14. The VFD shall include password protection against parameter changes.
- D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
 - 1. Start-up assistant
 - 2. Parameter assistants
 - a. PID assistant
 - b. Reference assistant
 - c. I/O assistant
 - d. Serial communications assistant
 - e. Option module assistant
 - f. Panel display assistant

- g. Low noise set-up assistant
- 3. Maintenance assistant
- 4. Troubleshooting assistant
- 5. Drive optimizer assistants
- E. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alphanumeric codes are not acceptable):
 - 1. Output Frequency
 - 2. Motor Speed (RPM, %, or Engineering units)
 - 3. Motor Current
 - 4. Motor Torque
 - 5. Motor Power (kW)
 - 6. DC Bus Voltage
 - 7. Output Voltage
- F. Serial Communications
 - The VFD shall have an EIA-485 port as standard. The standard protocols shall be ASHRAE 135 - BACnet. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" BTL Listed for BACnet. Use of non-certified protocols is not allowed.
 - 2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - a. Data Sharing Read Property B.
 - b. Data Sharing Write Property B.
 - c. Device Management Dynamic Device Binding (Who-Is; I-Am).
 - d. Device Management Dynamic Object Binding (Who-Has; I-Have).
 - e. Device Management Communication Control B.
 - 3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.
 - 4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours

(resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

- 5. Serial communication in bypass shall include, but not be limited to; bypass runstop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
- 6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.
- 7. The VFD shall include an independent PID loop for customer use. The independent PID loop would be used for chilled water value control. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.
- G. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.
- H. All VFD's through 25HP at 480 V shall be protected from input and output power miswiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.
- I. ADDITIONAL FEATURES Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
 - 1. Fieldbus adapters BACnet IP, shall be provided by adding of an optional card.
- J. BYPASS CONTROLLER

- 1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses are required. UL Listed motor overload protection shall be provided in both drive and bypass modes.
- 2. Bypasses for motor loads equivalent to 100 hp and lower shall be a full voltage non-reversing (FVNR) starter. Bypasses for motor loads equivalent to 125 hp and greater shall feature a reduced voltage non-reversing (RVNR) starter design.
- 3. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.
- 4. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 amps and this rating shall be indicated on the UL data label.
- 5. Drive Isolation Fuses To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted.
- 6. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage range. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.
- 7. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
- 8. Motor protection from single phase power conditions the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
- 9. The bypass system shall NOT depend on the VFD for bypass operation. The bypass system shall be designed for stand alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed.
- 10. Serial communications the bypass shall be capable of being monitored and controlled via serial communications. Communication shall be through BACnet IP.
- 11. Serial communication capabilities shall include, but not be limited to; bypass runstop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay

output – keypad "Hand" or "Auto" selected, bypass selected, and broken belt indication. The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.

- 12. The bypass serial communications shall allow control of the bypass' digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The bypass' digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the bypass' digital inputs shall be capable of being monitored by the DDC system.
- 13. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause only a warning or a fault and / or system shutdown.
- 14. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.
- 15. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open (motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.
- 16. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to fire a Form-C relay output, and / or over the serial communications protocol.
- 17. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 120 seconds.
- 18. There shall be a keypad adjustment to select manual or automatic transfer bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to the bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

- a. Over current
- b. Over voltage
- c. Under voltage
- d. Loss of analog input
- 19. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
- 20. The bypass shall include a two line, 20 character LCD display. The display shall allow the user to access and view:
 - a. Energy savings in US dollars
 - b. Bypass motor amps
 - c. Bypass input voltage– average and individual phase voltage
 - d. Bypass power (kW)
 - e. Bypass faults and fault logs
 - f. Bypass warnings
 - g. Bypass operating time (resettable)
 - h. Bypass energy (kilowatt hours resettable)
 - i. I/O status
 - j. Parameter settings / programming
 - k. Printed circuit board temperature
- 21. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.
 - a. Power-on (Ready)
 - b. Run enable
 - c. Drive mode selected
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Bypass H-O-A mode
 - j. Automatic transfer to bypass selected
 - k. Safety open
 - I. Damper opening
 - m. Damper end-switch made
- 22. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS / DDC system even with the VFD removed.

- 1. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.
 - a. System started
 - b. System running
 - c. Bypass override enabled
 - d. Drive fault
 - e. Bypass fault
 - f. Bypass H-O-A position
 - g. Motor proof-of-flow (broken belt)
 - h. Overload
 - i. Bypass selected
 - j. Bypass run
 - k. System started (damper opening)
 - I. Bypass alarm
 - m. Over temperature
- 23. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
- 24. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.
- K. Enclosures:
 - 1. Provide the VFD and bypass panels with the appropriate NEMA rated enclosure for the following applications:
 - a. Indoors: NEMA 1.
 - b. Indoors (mechanical rooms): NEMA 12.
 - c. Outdoors (Protected by overhang): NEMA 3R enclosure.
 - d. Outdoors (exposed to windblown dust or water): NEMA 4.
 - 2. Provide appropriate ventilation of VFD cabinetry to maintain ambient temperature rating of the drive based upon application. On outdoor installations appropriate ventilation shall be powered ventilation fan(s) and external 12"x12"x1"paper filter arranged so as to not allow paper filter to be exposed to rain.

2.3 SOURCE QUALITY CONTROL

- A. Shop, inspect and perform standard productions tests for each controller.
- B. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment. Notify the Owner at least seven days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify the Owner at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Section 01300 Administrative Requirements: Coordination and project conditions.
 - B. Verify that building environment can be maintained within the service and ambient temperature and humidity ratings required by the VFD manufacturer
- 3.2 INSTALLATION
 - A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
 - B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
 - C. Install in accordance with NEMA ICS 7.1.
 - D. Verify that mounting surface for VFDs are ready to receive work. Mount VFDs on the wall or at supports in locations identified on the drawings.
 - E. Tighten accessible connections and mechanical fasteners after placing controller.
 - F. Install fuses in fusible switches.
 - G. Select and install overload heater elements in motor controllers to match installed motor characteristics.
 - H. Install engraved plastic nameplates in accordance with Section 23 05 53.
 - I. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
 - J. Ground and bond controller in accordance with Section 26 05 26.
 - K. Controls installer shall provide all wiring and conduit associated with the control signals into and out of the VFD to the DDC EMS and as required for any motor control interlocks.
- 3.3 FIELD QUALITY CONTROL
 - A. Inspect and test in accordance with NETA ATS, except Section 4.
 - B. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

C. Perform power quality analysis per warranty requirements.

3.4 MANUFACTURER'S FIELD SERVICES

- A. VFD Start-up: Provide certified factory start-up for each drive by a factory authorized service center representative. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer. The following VFD start-up services are to be provided as a minimum:
 - 1. Service center technician shall be responsible for verifying correct installation, power and control wiring connections, starting-up the drive, and checking out for proper operation.
 - 2. Service center technician shall also provide all final adjustments to meet the specified performance requirements.
- 3.5 DEMONSTRATION AND TRAINING
 - A. Provide 16 hours of instruction to be conducted at the project site with manufacturer's representative. The training shall be conducted at 4 hour maximums. Contractor to also provide two sets of VFD operation manuals for use at the training session and then provide to the Owner after completion of the session.
- 3.6 VARIABLE FREQUENCY DRIVE START-UP SERVICE
 - A. Provide start-up commissioning of variable frequency drive and optional circuits by factory certified service technician experienced in start-up and repair services. Commissioning personnel shall be the same personnel that will provide factory service and warranty repairs at site. Sales personnel and other agents who are not factory certified technicians for drive field repair not acceptable.
 - B. Include checking for verification of proper operation and installation and interface wiring to building automation system. Include as a minimum:
 - 1. Verify contractor wire terminations to VFD optional circuitry.
 - 2. Verify proper operation and reliability of VFD, motor being driven and building automation system.
 - 3. Provide up to one hour of Owner/operator training on operation and service diagnostics during commissioning.
 - 4. Measure to verify proper operation on:
 - a. Motor voltage and frequency. Verify proper motor operation.
 - b. Control input for proper building automation system interface and control calibration.
 - c. Calibration check for:
 - d. Minimum speed.
 - e. Maximum speed.
 - f. Acceleration and deceleration rates.
 - g. Adjust as necessary.

- C. Configure VSD for automatic restart after a power failure or after an external fault is cleared.
- 3.7 COMMISSIONING
 - A. Refer to Commissioning Specifications, Section 01 81 10, for related commissioning requirements.
 - B. Contractor shall provide all necessary support to the commissioning team to implement commissioning plan as outlined in Section 01 81 10.

END OF SECTION 23 05 14

SECTION 23 05 17 - 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. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Sleeves.
 - 2. Sleeve layout plan for all penetrations through the post tensioned concrete structure. Plans shall be submitted for approval no later than 8 weeks prior to forming the PT concrete.
 - 3. Grout.

PART 2 - PRODUCTS

- 2.1 SLEEVES
 - A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- 2.2 GROUT
 - A. See requirements outlined in Division 3 and 4
 - B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - C. Characteristics: Nonshrink; recommended for interior and exterior applications.

- D. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- E. 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. 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 sleeveseal system.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 "Joint Sealants."
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 "Penetration Firestopping."

3.2 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 wall sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
 - 2. Concrete Slabs above Grade:

- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
- b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
- 3. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

END OF SECTION 23 05 17

SECTION 23 05 18 - CONTROL WIRING

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Basic Requirements: Provisions of Section 23 00 10, Basic HVAC Requirements are part of this Section.
 - C. Section 230900, Instrumentation and Controls for HVAC
 - C. Refer to Division 26 for electrical wiring requirements.
- 1.2 WORK INCLUDED
 - A. BMS Control System Wiring.
 - B. Thermostat and Aquastat Wiring for Unit Heaters.
 - C. Interlock Wiring for Refrigeration Equipment.
 - D. Fire Pump and Jockey Pump Interlock Wiring.
 - E. Fire Suppression System Interlock Wiring.
 - F. Plumbing Systems Interlock Wiring.
 - G. Water Treatment Equipment Interlock Wiring.
 - H. Interior & Exterior Lighting Control Wiring
- 1.3 DEFINITIONS
 - A. Control Wiring: All wiring, high or low voltage other than power wiring, required for the proper operation of the mechanical systems.
 - B. Power Wiring: All line voltage wiring to the mechanical equipment. Line voltage which also serves as a control circuit, such as a line voltage thermostat, or involves interlocking with a damper, shall be considered control wiring.

1.4 QUALITY ASSURANCE

A. All work will be in accordance with the requirements of the National Electrical Code.

1.5 SUBMITTALS

A. Submittals are not required.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All material used in the completion of the wiring under this section will comply with the requirements of Division 26 Electrical and Section 23 09 13 – Instrumentation and Control Devices for HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cooperate completely with the contractor for Division 26.
- B. Provide all conduit, wire and accessories necessary to complete the control wiring as specified under WORK INCLUDED.
- C. Because of variations in requirements from manufacturer to manufacturer, all details may not be included in the Contract Documents. This sub-contractor must obtain approved coordinated wiring diagrams before proceeding with the control wiring.
- D. All control wiring shall be properly installed in an approved raceway system or when allowed, run exposed in concealed spaces. All control wiring run in exposed areas shall be in an approved raceway unless otherwise noted.
- E. Control wire run exposed shall be neatly bundled and routed parallel and/or perpendicular to building structure or equipment casing. Routing of wire shall be so that it does not interfere, chafe or obstruct service or maintenance of the equipment served.
- F. Exposed control wire shall be properly secured and/or supported within equipment encloses. Cable shall be secured on no greater than 18" centers.
- G. All openings made for the passing of control wire shall be properly bushed to prevent chafing. Hole size shall be suitable for the quantity of wires or tubing passing through

while allowing for ease of pulling and future expansion. Oversized holes beyond these requirements are not allowed.

- H. Holes made within air handling equipment which may allow the transfer or bypassing of air shall be properly sealed after wire is pulled. Expanding foam sealant and proper backing material will be acceptable. Seal shall be suitable for maximum unit operating pressures. Sealant shall be in accordance with the requirements of Division 7 sections.
- I. Attachments of control devices, raceway and cable supports shall be made with proper attachments. Self-drilling screws which result in exposed end will not be acceptable. Bolts and nuts shall be used with bolt head exposed to view. All fasteners located where exposed to weather or moisture shall be stainless steel or cadmium plated.
- J. Any opening, holes or cuts in equipment enclosures or building structure not used shall be neatly sealed. On equipment, the seal or patch shall be of similar material sealed and painted to match.
- K. The BMS Contractor shall clean all unused or scrap material from the equipment enclosure.
- L. All control wire shall be identified by proper cable identification methods. Verify how cables shall be labeled with the Owner's Representative prior to the start of work. All termination shall be labeled and labels clearly visible.
- M. All control devices, cabinets, equipment and raceways shall be labeled. Verify how the hardware shall be labeled with the Owner's Representative prior to the start of work.
- N. Splices in control wire are not allowed unless the length of run is too great to allow for a continuous run. When splices become necessary, they shall be solder connected with heat shrink tubing. When raceway is used, all splices shall be in junction boxes.
- O. Control devices (i.e., flow switches), connected to cold equipment where the possibility of condensation may occur shall be vaporproof type. The connecting conduit shall be properly sealed with spray type foam after the wires are pulled through. If this is not possible, a weatherproof junction box shall be close mounted to the device to allow for proper moisture sealing. Conduit connections shall be sealed with a silicon type caulk/sealant.
- P. All control devices or wiring located exposed to weather or moisture shall be in an approved raceway system. This system shall be properly supported and sealed to prohibit moisture convection or transfer. Provide flexible conduit similar to seal tight for connection to all equipment. EMT and set screw fittings are not acceptable. All exterior raceway shall be IMC (Intermediate Metallic Conduit) rigid galvanized conduit or better with threaded fittings.
- Q. Where a disconnect switch is mounted between an adjustable frequency drive and the motor, the disconnect must have a late make, early break auxiliary contact. This contact

shall be wired into the AFD control circuit so that the control circuit is disconnected before the power circuit it broken.

R. BMS Contractor to fully review the electrical drawings for interlock wiring required for exterior and interior lighting control. BMS contractor to coordinate with the electrical contractor all relays, contactors, programming and wiring required.

END OF SECTION 23 05 18

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.
- 1.2 SUMMARY
 - A. Section Includes:
 - 1. Thermometers.
 - 2. Thermowells.
 - 3. Gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
 - 7. Flowmeters.
 - 8. Thermal-energy meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves and installation instructions.
- B. Shop Drawings: Schedule for thermometers, gages, flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer, gages, flowmeters and thermalenergy meter, signed by product manufacturer.
- D. Wiring Diagrams: For power, signal, and control wiring.

E. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction an installation of meters and gauges.
- B. Design Criteria: The drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gauges and are based on the specific manufacturer types and models indicated.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below to match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide six spare pressure gauges for use with valved pressure gauge outlets.
 - 2. Provide six spare thermometers for use with pressure-temperature test stations.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - <u>3.</u> Winters Instruments U.S.
 - 3.4. Weksler Glass Thermometer Corp.
- B. Standard: ASME B40.200.
- C. Case: Cast aluminum 9 inches nominal size unless otherwise indicated.
- D. Tube: Red reading organic-liquid filled glass, with magnifying lens.
- E. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings in deg. F.
- F. Window: Glass or plastic.

- G. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- H. Stem: Stainless steel and of stem length to suit installation pipe size.
 - 1. Below NPS 4: 3 1/2 inch stem, elbow mounted.
 - 2. NPS 4 NPS 8: 3 1/2 inch stem.
 - 3. NPS 10 NPS 14: 6 inch stem.
 - 4. NPS 16 NPS 20: 9 inch stem.
 - 5. NPS 24: 12 inch stem.
 - 6. Over NPS 24: Stem length equal to 50% pipe diameter.
- I. Design for Thermowell Installation: Bare stem.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
- 2.2 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Winters Instruments U.S.
 - B. Case: Dry type, cast aluminum, 4-1/2-inch diameter.
 - C. Element: Bourdon tube or other type of pressure element. Brass, bronze bushed, recalibrator type.
 - D. Movement: Mechanical, connecting element and pointer.
 - E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - F. Pointer: Red metal.
 - G. Window: Glass or plastic.
 - H. Ring: Chrome plated metal.
 - I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
 - J. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation pipe size:

- 1. Below NPS 4: 3 1/2 inch stem, elbow mounted.
- 2. NPS 4 NPS 8: 3 1/2 inch stem.
- 3. NPS 10 NPS 14: 6 inch stem.
- 4. NPS 16 NPS 20: 9 inch stem.
- 5. NPS 24: 12 inch stem.
- 6. Over NPS 24: Stem length equal to 50% pipe diameter.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Winters Instruments U.S.
- B. Case: Dry type, cast aluminum, 4-1/2-inch diameter with holes for panel mounting.
- C. Element: Bourdon tube or other type of pressure element. Brass, bronze brushed, recalibrator type.
- D. Movement: Mechanical, connecting element and pointer.
- E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Pointer: Red metal.
- G. Window: Glass or plastic.
- H. Ring: Black aluminum.
- I. Connector: Bottom or Back union type. Connecting tubing shall be double braided bronze armor over copper capillary.
- J. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation pipe size:
 - 1. Below NPS 4: 3 1/2 inch stem, elbow mounted.
 - 2. NPS 4 NPS 8: 3 1/2 inch stem.
 - 3. NPS 10 NPS 14: 6 inch stem.
 - 4. NPS 16 NPS 20: 9 inch stem.
 - 5. NPS 24: 12 inch stem.
 - 6. Over NPS 24: Stem length equal to 50% pipe diameter.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
- L. For use in locations where temperature sensing bulb is located more than 5 feet.

2.4 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Standard: ASME B40.200.
- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Provide with separable brass socket connection, cap and chain.
- D. Material for Use with Copper Tubing: CNR or CUNI.
- E. Material for Use with Steel Piping: CRES.
- F. Type: Stepped shank unless straight or tapered shank is indicated.
- G. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
- H. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
- I. Bore: Diameter required to match thermometer bulb or stem.
- J. Insertion Length: Length required to match thermometer bulb or stem.
- K. Lagging Extension: Include on thermowells for insulated piping and tubing.
- L. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- M. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Winters Instruments U.S.

- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, cast aluminum 4-1/2-inch nominal diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, stainless steel, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 6. Pointer: Dark-colored metal.
 - 7. Window: Glass.
 - 8. Ring: Brass.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.
 - 1. Case: Dry type, cast aluminum 4-1/2-inch diameter with holes for panel mounting.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, stainless steel, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Dark-color metal.
 - 7. Window: Glass.
 - 8. Ring: Brass.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
 - 12. For use with sensing lines up to 25 feet in length.
- D. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 or NPS 1/2 as applicable, ASME B1.20.1 pipe threads, brass or stainless-steel needle type.
 - 2. Snubbers: ASME B40.100, brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads, and piston-type surge-dampening device suitable for system fluid and working pressure. Include extension for use on insulated piping.

2.6 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 Industries, Inc.; Water Products Div.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- D. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber valves.
- E. Test Kit: Furnish four test kits containing one pressure gage and adaptor, two thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
 - 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inchdiameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 - 3. Carrying case shall have formed instrument padding.

2.7 WAFER-ORIFICE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements:
 - 1. ABB, Inc.; ABB Instrumentation.
 - 2. Armstrong Pumps, Inc.
 - 3. Badger Meter, Inc.; Industrial Div.
 - 4. Bell & Gossett; ITT Industries.
 - 5. Meriam Instruments Div.; Scott Fetzer Co.
- B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.

- D. Pressure Rating: 300 psig (2070 kPa).
- E. Temperature Rating: 250 deg F (121 deg C).
- F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - 1. Scale: Gallons per minute (Liters per second).
 - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- H. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses in carrying case.
 - 1. Scale: Gallons per minute (Liters per second).
 - 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- I. Operating Instructions: Include complete instructions with each flowmeter.

2.8 VENTURI FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Pumps, Inc.
 - 2. Badger Meter, Inc.; Industrial Div.
 - 3. Bailey-Fischer & Porter Co.
 - 4. Flow Design, Inc.
 - 5. Gerand Engineering Co.
 - 6. Hyspan Precision Products, Inc.
 - 7. Leeds & Northrup.
 - 8. McCrometer, Inc.
 - 9. Preso Meters Corporation.
 - 10. Victaulic Co. of America.
- B. Description: Differential-pressure design for installation in piping; with calibrated flowmeasuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Bronze, brass, or factory-primed steel, as noted below; with brass fittings and attached tag with flow conversion data.
 - 1. NPS 1/2 (DN 15) through NPS 2 (DN 50): Bronze or brass.
 - 2. NPS 2 1/2 (DN 65) through NPS 8 (DN 200): Factory primed cast steel.

- 3. NPS 10 (DN 250) and larger: Factory primed fabricated steel.
- D. Pressure Rating: 250 psig (1725 kPa).
- E. Temperature Rating: 250 deg F (121 deg C).
- F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.
- H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - 1. Scale: Gallons per minute (Liters per second).
 - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- J. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses in carrying case.
 - 1. Scale: Gallons per minute (Liters per second).
 - 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- K. Operating Instructions: Include complete instructions with each flowmeter.

2.9 TURBINE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Badger Meter, Inc.; Industrial Div.
 - 2. Bailey-Fischer & Porter Co.
 - 3. Data Industrial Corp.
 - 4. Engineering Measurements Company.
 - 5. ERDCO Engineering Corp.
 - 6. Fischer, George Inc.
 - 7. Hoffer Flow Controls, Inc.
 - 8. ISTEC Corporation.
 - 9. Midwest Instruments & Controls Corp.
 - 10. ONICON Incorporated.
 - 11. SeaMetrics Inc.
 - 12. Sponsler Company, Inc.
 - 13. Thermo Measurement Ltd.
 - 14. Venture Measurement.

- B. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute (liters per second).
- C. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.
- D. Pressure Rating: 150 psig (1035 kPa) minimum.
- E. Temperature Rating: 180 deg F (82 deg C) minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
- G. Accuracy: Plus or minus 2-1/2 percent.

2.10 VORTEX-SHEDDING FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bailey-Fischer & Porter Co.
 - 2. Engineering Measurements Company.
 - 3. ISTEC Corporation.
 - 4. MCO/Eastech, Inc.
 - 5. Schlumberger Limited; Measurement Div.
 - 6. Venture Measurement.
- B. Description: Inline type for installing between pipe flanges and measuring flow directly in gallons per minute (liters per second).
- C. Construction: Stainless-steel body; with integral transmitter and direct-reading scale.
- D. Pressure Rating: 1000 psig (6900 kPa) minimum.
- E. Temperature Rating: 500 deg F (260 deg C) minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
- G. Integral Transformer: For low-voltage power operation.
- H. Accuracy: Plus or minus 7/10 percent for liquids and 1-1/4 percent for gases.

2.11 PITOT-TUBE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dieterich Standard Inc.
 - 2. Meriam Instruments Div.; Scott Fetzer Co.
 - 3. Preso Meters Corporation.
 - 4. Taco, Inc.
 - 5. Veris Industries.
- B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute (liters per second).
- C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.
- D. Pressure Rating: 150 psig (1035 kPa) minimum.
- E. Temperature Rating: 250 deg F (121 deg C) minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
- G. Integral Transformer: For low-voltage power connection.
- H. Accuracy: Plus or minus 1 percent for liquids and gases.

2.12 FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brooks Instrument Div.; Emerson Electric Co.
 - 2. Dwyer Instruments, Inc.
 - 3. Ernst Gage Co.
 - 4. Eugene Ernst Products Co.
 - 5. McCrometer, Inc.
 - 6. OPW Engineered Systems; Dover Corp.
 - 7. Penberthy, Inc.
- B. Description: Instrument for installation in piping systems for visual verification of flow.
- C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.
- D. Pressure Rating: 125 psig (860 kPa).

- E. Temperature Rating: 200 deg F (93 deg C).
- F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2.13 INSERTION-TURBINE, THERMAL-ENERGY METER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Data Industrial Corp.
 - 2. ONICON Incorporated.
 - 3. Thermo Measurement Ltd.
- B. Description: Flow sensor, strainer, two temperature sensors, transmitter, meter, and connecting wiring.
- C. Flow Sensor: Insertion-type turbine or paddle-wheel element with corrosion-resistantmetal body and transmitter.
 - 1. Pressure Rating: 125 psig (860 kPa).
 - 2. Temperature Range: 40 to 250 deg F (5 to 121 deg C).
- D. Meter: Solid-state integrating type with integral battery pack.
 - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
 - 2. Accuracy: Plus or minus 1 percent.
 - 3. Battery Pack: Five-year lithium battery.
- E. Strainer: Full size of main line piping.

2.14 INLINE-TURBINE, THERMAL-ENERGY METER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Engineering Measurements Company.
 - 2. Hoffer Flow Controls, Inc.
 - 3. ISTEC Corporation.
 - 4. Thermo Measurement Ltd.
 - 5. Venture Measurement.
- B. Description: Flow sensor, strainer, two temperature sensors, transmitter, meter, and connecting wiring.

- C. Flow Sensor: Turbine-type water meter with corrosion-resistant-metal body and transmitter.
 - 1. Pressure Rating: 150-psig (1035-kPa) minimum working-pressure rating.
 - 2. Temperature Range: 40 to 250 deg F (5 to 121 deg C).
- D. Meter: Solid-state integrating type with integral battery pack.
 - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
 - 2. Accuracy: Plus or minus 1 percent.
 - 3. Battery Pack: Five-year lithium battery.
- E. Strainer: Full size of main line piping.

2.15 ULTRASONIC, THERMAL-ENERGY METER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Controlotron Corporation.
 - 2. Engineering Measurements Company.
 - 3. Mesa Laboratories, Inc.; Nusonics Div.
- B. Description: Flow sensor, two temperature sensors, transmitter, meter, and connecting wiring.
- C. Flow Sensor: Strap-on or integral ultrasonic type with transmitter.
- D. Meter: Solid-state integrating type with integral battery pack.
 - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
 - 2. Accuracy: Plus or minus 1 percent.
 - 3. Battery Pack: Five-year lithium battery.
- E. Strainer: Full size of main line piping.

2.16 DIFFERENTIAL PRESSURE INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ITT Barton.
 - 2. Meriam Instrument Co.
 - 3. Rosemount Engineering Co.

- B. Description: Pressure sensor, two pressure sensors, meter and connecting tubing.
- C. Die cast aluminum, 6 inch (152 mm) diameter.
- D. Pressure Connections: Brass, NPS 1/4 (DN 8), bottom outlet type, unless otherwise indicated.
- E. Pressure-Element Assemblies: Stainless steel bellows and torque tube; self-draining.
- F. Movement: Jeweled rotary type with zero and range adjustment screws.
- G. Manifold: Stainless steel with carbon steel tubing.
- H. Scale: Uniform, calibrated in psig (kPa).
- I. Accuracy: 1/2 of 1 percent of full scale range.
- J. Pressure Rating: 500 psig (3450 kPa).

PART 3 - EXECUTION

- 3.1 THERMOMETER APPLICATIONS
 - A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 3. Chilled water lines at exit of equipment rooms.
 - 4. Other locations as noted on drawings.
 - B. Install direct-mounting, vapor-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 3. Chilled water lines at exit of equipment rooms.
 - 4. Other locations as noted on drawings.
 - C. Install remote-mounting, vapor-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 3. Chilled water lines at exit of equipment rooms.
 - 4. Outside air, return air and mixed air ducts.

- 5. Other locations as noted on drawings.
- D. Install bimetallic-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 3. Chilled water lines at exit of equipment rooms.
 - 4. Other locations as noted on drawings.
- E. Install liquid-filled-case-type, vapor-actuated dial thermometers at suction and discharge of each pump.
- F. Provide the following temperature ranges for thermometers:
 - 1. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
 - 2. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale.

3.2 GAGE APPLICATIONS

- A. Install liquid-filled-case-type pressure gages at suction and discharge of each pump, between shut-off valve and pump. Provide compound type gauge if subject to negative pressure.
- B. Install pressure gauges at other locations as noted on the drawings.
- C. Pressure gauge ranges shall be selected so that normal system operating pressures occur at the center portion of the scale range.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
- E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- F. Install remote-mounting pressure gages on panel.

- G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.
- H. Install test plugs in tees in piping.
- I. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- K. Install flowmeter elements in accessible positions in piping systems.
- L. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- M. Install wafer-orifice flowmeter elements between pipe flanges.
- N. Install permanent indicators on walls or brackets in accessible and readable positions.
- O. Install connection fittings for attachment to portable indicators in accessible locations.
- P. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- Q. Assemble components and install thermal-energy meters.
- R. Mount meters on wall if accessible; if not, provide brackets to support meters.
- S. Install pressure-temperature test stations adjacent to each bulb for controllers, remote temperature indication and recording thermometers, and at other points where noted on drawings.
- T. Install valved outlets for pressure gauges at cooling water supply and return for coil assemblies, for other equipment not noted to receive permanent pressure gauges, and at other points where noted on drawings.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy-meter transmitters to meters.

3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL - DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Basic Requirements: Provisions of Section 23 00 10 Basic HVAC Requirements are part of this Section.
- C. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- D. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUMMARY

- A. General: Provide valves, cocks and specialties which are required for piping systems specified in other sections of these specifications.
- B. Section Includes:
 - 1. Bronze ball valves.
 - 2. Iron, grooved-end ball valves.
 - 3. Iron, single-flange butterfly valves.
 - 4. Iron, grooved-end butterfly valves.
 - 5. High-performance butterfly valves
 - 6. Bronze swing check valves.
 - 7. Iron swing check valves.
 - 8. Iron, grooved-end swing-check valves.
 - 9. Chainwheels.
 - 10. Flow Balancing Valves
- C. Related Sections:
 - 1. Section 23 05 53 Identification for HVAC Piping and Equipment for valve tags and schedules.

- 1.3 ABBREVIATIONS
 - A. EPDM: Ethylene propylene copolymer rubber.
 - B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
 - C. NRS: Nonrising stem.
 - D. OS&Y: Outside screw and yoke.
 - E. RS: Rising stem.
 - F. SWP: Steam working pressure.

1.4 APPLICABLE STANDARDS

- A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 230010.
- B. Pressure and Temperature Rating: Valves shall have a pressure and temperature rating equal to or exceeding the piping in which they are installed, except that valves shall be designed for a minimum steam working pressure (SWP) of 125 psi; water-oil-gas (WOG) pressure of 200 psi.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Manufacturer's data indicating body material, valve design, design pressure and temperature ratings and classification, end connection details, seat materials, trim materials, dimensions, required clearances, and installation instructions.
- B. General: Include the following data:
 - 1. Manufacturers Literature:
 - a. Dimensional outline drawing of each valve listed in this section including sizes available and pressure limitations.
 - b. Outline drawing of each calibrated balancing and flow measuring valve including flow and pressure limitations.
 - c. Outline drawing of each safety and pressure relief valve including discharge capacity and pressure limitations.
 - 2. Installation Instructions: Manufacturer's printed installation instructions for all valves including copies shipped with the valves.

- 1.6 QUALITY ASSURANCE
 - A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
 - B. To assure uniformity and compatibility, all grooved end valves and adjoining couplings shall be the products of a single manufacturer
 - C. 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.

1.7 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 ball valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. 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.

1.8 BASIC VALVE REQUIREMENTS

A. General: Valves and cocks may not be indicated in every instance on the drawings, but whether or not shown, all valves, cocks and check valves necessary for the proper operation of the system shall be furnished and installed. Valves shall have rising stems except in locations where space is limited; in these locations non-rising stem valves of equivalent material and pressure class will be accepted. Valves shall have the manufacturer's name or trademark, recommended service pressure, and size indicated by raised letters cast on the valve body. PART 2 - PRODUCTS

- 2.1 GENERAL REQUIREMENTS FOR VALVES
 - A. Refer to specific sections in Part 3 for applications of valves.
 - B. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
 - C. 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.
 - D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
 - E. Valve Sizes: Same as upstream piping unless otherwise indicated.
 - F. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
 - G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. 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. Memory stops that are fully adjustable after insulation is applied.
 - 2. Butterfly Valves: With extended neck.
 - H. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - I. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
 - A. Two-Piece, Full-Port, Brass or Stainless Steel Ball Valves with Brass Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Flow-Tek
- 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, Stainless Steel
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Blowout-proof stem
 - i. Stem: Bronze, Stainless Steel
 - j. Stem Seals: Double O-ring
 - k. Ball: Chrome-plated brass or Stainless Steel
 - I. Port: Full.

2.3 IRON, GROOVED – END BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic
 - b. Owner-approved substitution
 - 2. Description:
 - a. SWP Rating: 800 psi.
 - b. Body Design: Two piece, Standard Port.
 - c. Body Material: Ductile Iron conforming to ASTM A-536, painted black enamel.
 - d. Ends: Ductile Iron conforming to ASTM A-536, painted black enamel.
 - e. Seats: TFE.
 - f. Stem: Micro-finished Steel.
 - g. Ball: Micro-finished Nickel-Plated Carbon Steel.
 - h. Port: Standard.

- 2.4 IRON BALL VALVES
 - A. Class 125, Iron/Carbon Steel Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Flow-Tek F 15
 - 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron, carbon steel
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.5 IRON, SINGLE – FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.

- f. Stem: One- or two-piece stainless steel.
- g. Disc: stainless steel.

2.6 IRON, GROOVED – END BUTTERFLY VALVES

- A. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
 - b. Owner-approved substitution
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 300 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: stainless steel or ductile-iron; offset
 - f. Seal: EPDM rated continuous-duty to 250F for 12" and smaller and 230F for 14" and larger.

2.7 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bray Controls
- b. Milwaukee Valve Company
- c. NIBCO INC
- d. Stockham; Crane Energy Flow Solutions
- e. Tyco Valves & Controls
- 2. Description:
 - a. Standard: MSS SP-68. API-609
 - b. CWP Rating: 285 psig at 100 deg F

- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange
- d. Body Material: Carbon steel, ductile iron, or stainless steel
- e. Seat: Reinforced PTFE or metal
- f. Stem: Stainless steel; offset from seat plane. Stem to be blow-out proof
- g. Disc: 316 stainless steel
- h. Service: Bidirectional

2.8 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requiremengvb-p0[=p-[ts, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.9 BRONZE LIFT CHECK VALVES

A. Class 125 Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Stockham; Crane Energy Flow Solutions
- b. Milwaukee Valve Company
- c. NIBCO INC
- B. Description:
 - 1. Standard: MSS SP-80, Type 1
 - 2. CWP Rating: 200 psig
 - 3. Body Design: Vertical
 - 4. Body Material: ASTM B 61 or ASTM B 62, bronze
 - 5. Ends: Threaded
 - 6. Disc: Bronze
- 2.10 IRON SWING CHECK VALVES
 - A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Powell Valves.

- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
- B. Class 250, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
- 2.11 IRON, GROOVED -END SWING CHECK VALVES
 - A. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
 - b. Owner-approved substitution
 - 2. Description:
 - a. CWP Rating 12" and smaller: 300 psig (2070 kPa).
 - b. CWP Rating 14" and larger: 230 psig (1586 kPa)

- c. Body Material: ASTM A 536 or ASTM A 395, ductile iron.
- d. Seal: EPDM.
- e. Disc: Spring operated, ductile iron or stainless steel.

2.12 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products, Inc
 - b. Milwaukee Valve Company
 - c. NIBCO INC
 - 2. Description:
 - a. Standard: MSS SP-125
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig
 - d. Body Material: ASTM A 126, gray iron
 - e. Style: Compact wafer
 - f. Seat: Bronze

2.13 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. NIBCO INC
- b. Milwaukee Valve Company
- c. Stockham; Crane Energy Flow Solutions
- 2. Description:
 - a. Standard: MSS SP-71, Type I
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig
 - c. NPS 14 to NPS 24, CWP Rating: 150 psi
 - d. Body Design: Clear or full waterway

- e. Body Material: ASTM A 126, gray iron with bolted bonnet
- f. Ends: Flanged
- g. Trim: Bronze
- h. Gasket: Asbestos free
- i. Closure Control: Factory-installed, exterior lever and weight

2.14 FLOW BALANCING VALVES

- A. Automatic Flow Control Valve: Provide automatic flow control valves with variable openings which respond to pressure, factory set to control the water flow over an operating pressure differential at least 10 times the minimum required for full flow conditions. Valves shall be tamper proof when installed, and shall have body pressure tappings with a set of pressure and temperature test ports. Valves shall have flanged or grooved ends or a union either integral or directly adjacent to permit replacement of the control element. The automatic flow controls shall be selected for the project by the manufacturer to provide flow rates matching the equipment requirements, including any increased or decreased flow rates that are indicated.
 - 1. Body: Brass or ferrous metal.
 - 2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
 - 3. Combination Assemblies: Include bronze or brass-alloy ball valve.
 - 4. Identification Tag: Marked with zone identification, valve number, and flow rate.
 - 5. Size: Same as pipe in which installed.
 - 6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
 - 7. Minimum CWP Rating: 175 psig.
 - 8. Maximum Operating Temperature: 200 deg F.
 - 9. Minimum Differential operating pressure: 5-60 psid (35-414 KpA).
- B. Manufacturer:
 - 1. Autoflow, Inc.
 - 2. Griswold
 - 3. IMI Flow Design
 - 4. Victaulic

- C. Calibration Meter: Provide one portable differential pressure gauge calibration meter kit of same manufacturer as valves. Kit shall be housed in a hand-carrying case and shall contain all devices required, including pressure gauges, 5 foot meter hoses with disconnect ends, positive shutoff valves, operating instructions, and flow versus pressure drop curves, to enable testing and balancing of each size and type of balancing valve installed.
- 2.15 Combination Balancing and Shut-off valve:
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Tour & Anderson.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett; a Xylem brand.
 - B. Description:
 - 1. Body: "Y" pattern, modified, equal percentage globe style. Brass up to 2 inch; ductile iron for 2-1/2 inch and larger.
 - 2. Bronze trim.
 - 3. Precision flow measurement.
 - 4. Precision flow balancing.
 - 5. Positive drip tight shut-off.
 - 6. Two (2) 1/2 inch NPT metering ports with nordel check valves and gasketed caps located on both sides of the valve seat.
 - 7. Two (2) additional 1/4 inch NPT connections with brass plugs on opposite side of the metering ports for use as drain connections.
 - 8. Drain connections and metering ports are to be interchangeable.
 - 9. Handwheel with hidden memory feature.
 - 10. Minimum CWP Rating: 175 psig or 300 psig.
 - 11. Maximum Operating Temperature: 200 deg F or 250 deg F.

2.16 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to butterfly valve stems.

- 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
- 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.
- 5. Provide safety cable system for each chain wheel. Safety cable system shall consist of cable, clips, and eyebolts made from Type 316 stainless steel

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. Examine grooved ends for conditions that might cause leakage. Ends should be free from indentations or projections in the area from valve end to groove
 - F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions, grooved-joint couplings 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 butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

- F. Install isolation/shutoff valve at all main risers and main branch takeoffs, to permit isolation of piping sections for drainage.
- G. Install isolation/shutoff valves on each inlet and outlet of each piece of equipment to which water is piped to allow isolation, venting and drainage. Provide a flange, union, or groove between the valve and the equipment to permit disconnection, removal and service.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Y-pattern horizontal swing check valves shall be used in vertical lines.
 - 3. Horizontal swing check valves shall be used with ball valves;
 - 4. Wafer check valves shall be used with butterfly valves.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or <u>High Performance</u> butterfly valves.
 - 2. Butterfly Valve Dead-End Service: <u>High Performance</u> Single-flange (lug) type.
 - 3. Throttling Service: Ball or <u>High Performance B</u>butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valveend option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 CHILLED - WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller above-grade:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, standard port, bronze with bronze trim.
 - 3. Bronze Swing Check Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger above-grade:
 - 1. Iron Steel Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
 - 2. IronSteel, Single-Flange <u>High Performance</u> Butterfly Valves, NPS 2-1/2 and Larger: <u>200 CWPClass 150</u>, <u>EPDM seat, Reinforced PTFE</u>, stainless steel disc and stem
 - 3. IronSteel, High Performance Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 24: 300 CWP.Class 150.
 - 4. Iron Swing Check Valves: Class <u>125150</u>, metal seats.
 - 5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
 - 6. Iron, Grooved-End Check Valves, NPS 14 to NPS 24: 230 CWP

3.6 FLOW BALANCING VALVES

- A. Location: Provide flow balancing valves where indicated. The exact location shall be determined using field measurements relating to the specific piping arrangement and the manufacturer's recommendations.
- B. Manufacturer' Recommendation: Install in accordance with manufacturer's recommendations including valve orientation and increases or decreases in pipe size at points of installation, together with minimum recommended lengths of straight pipe before and after points of installation.
- C. Calibration Meter: At the conclusion of the system test and balance and prior to final completion the meter shall be turned over to, and shall become the property of, the Owner.

3.7 DRAIN VALVES

A. Location: Install drain valves at the base of all water piping risers (both supply and return) and at all low points in the piping system. Drain valves shall be fitted with schedule 80 hose connection end with cap unless otherwise indicated.

3.8 CONDENSER -WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger below and above-grade - exterior:

- 1. Iron, Single-Flange Butterfly Valves, 200 CWP, EPDM seat, stainless steel disc and stem.
- 2. Iron, Grooved-End Butterfly Valves, 300 CWP, EPDM seat, ductile-iron disc and stainless steel stem (above-grade)
- B. Pipe NPS 2-1/2 and Larger above-grade interior:
 - 1. Iron, Single-Flange Butterfly Valves, 200 CWP, EPDM seat, stainless steel disc and stem.
 - 2. Iron, Grooved-End Butterfly Valves, 300 CWP, EPDM seat, ductile-iron disc and stainless steel stem.

END OF SECTION 23 05 23

SECTION 23 05 23.01- VALVES FOR PCA PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Basic Requirements: Provisions of Section 23 00 10 Basic HVAC Requirements are part of this Section.
- C. Base Specification: Provisions of Section 23 05 23 General Duty Valves for HVAC Piping is part of this Section.
- D. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- E. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUMMARY

- A. General: Provide valves, cocks and specialties which are required for piping systems specified in other sections of these specifications.
- B. Section Includes:
 - 1. Bronze ball valves.
 - 2. Bronze swing check valves.
 - 3. Butterfly valves.
 - 4. Flow Balancing Valves
 - 5. Chainwheels
- C. Related Sections:
 - 1. Section 23 05 53 Identification for HVAC Piping and Equipment for valve tags and schedules.

1.3 ABBREVIATIONS

- A. EPDM: Ethylene propylene copolymer rubber.
- B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- C. NRS: Nonrising stem.
- D. OS&Y: Outside screw and yoke.

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- E. RS: Rising stem.
- F. SWP: Steam working pressure.

1.4 APPLICABLE STANDARDS

- A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 230010.
- B. Pressure and Temperature Rating: Valves shall have a pressure and temperature rating equal to or exceeding the piping in which they are installed, except that valves shall be designed for a minimum steam working pressure (SWP) of 125 psi; water-oil-gas (WOG) pressure of 200 psi.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.
- B. General: Include the following data:
 - 1. Manufacturers Literature:
 - a. Dimensional outline drawing of each valve listed in this section including sizes available and pressure limitations.
 - b. Outline drawing of each calibrated balancing and flow measuring valve including flow and pressure limitations.
 - c. Outline drawing of each safety and pressure relief valve including discharge capacity and pressure limitations.
 - 2. Installation Instructions: Manufacturer's printed installation instructions for all valves including copies shipped with the valves.

1.6 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.

1.7 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.

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- 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.

1.8 BASIC VALVE REQUIREMENTS

A. General: Valves and cocks may not be indicated in every instance on the drawings, but whether or not shown, all valves, cocks and check valves necessary for the proper operation of the system shall be furnished and installed. Valves shall have rising stems except in locations where space is limited; in these locations non-rising stem valves of equivalent material and pressure class will be accepted. Valves shall have the manufacturer's name or trademark, recommended service pressure, and size indicated by raised letters cast on the valve body.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. 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.
 - 2. 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.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Brass or Stainless-Steel Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Flow-Tek
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze, Stainless Steel
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze, Stainless Steel
 - h. Stem Seals: Double O-ring
 - i. Ball: Chrome-plated brass or Stainless Steel
 - j. Port: Standard.

2.3 IRON, SINGLE – FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless Steel Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: stainless steel.

2.4 IRON, SINGLE – FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: stainless steel.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

- A. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. NPS 8 and Smaller CWP Rating: 300 psig.
 - c. NPS 10 and Larger CWP Rating: 200 psig.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: stainless steel.
 - g. Seal: EPDM.

2.6 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.7 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
 - e.
 - 2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.8 FLOW BALANCING VALVES

- A. Automatic Flow Control Valve: Provide automatic flow control valves with variable openings which respond to pressure, factory set to control the water flow over an operating pressure differential at least 10 times the minimum required for full flow conditions. Valves shall be tamper proof when installed, and shall have body pressure tappings with a set of pressure and temperature test ports. Valves shall have flanged or grooved ends or a union either integral or directly adjacent to permit replacement of the control element. The automatic flow controls shall be selected for the project by the manufacturer to provide flow rates matching the equipment requirements, including any increased or decreased flow rates that are indicated. The control range pressure differential shall not exceed 3 to 40 psi.
- B. Manufacturer:
 - 1. Autoflow, Inc.
 - 2. Griswold
 - 3. Approved substitution
- C. Calibration Meter: Provide one portable differential pressure gauge calibration meter kit of same manufacturer as valves. Kit shall be housed in a hand-carrying case and shall contain all devices required, including pressure gauges, 5 foot meter hoses with disconnect ends, positive shutoff valves, operating instructions, and flow versus pressure drop curves, to enable testing and balancing of each size and type of balancing valve installed.
2.9 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to butterfly valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast 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 butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install isolation/shutoff valve at all main risers and main branch takeoffs, to permit isolation of piping sections for drainage.

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- G. Install isolation/shutoff valves on each inlet and outlet of each piece of equipment to which water is piped to allow isolation, venting and drainage. Provide a flange, union, or groove between the valve and the equipment to permit disconnection, removal and service.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Wafer check valves shall be used with butterfly valves.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 4. For Grooved-End Steel Piping: Valve ends may be grooved.

3.5 <u>GLYCOL CHILLED - WATER VALVE SCHEDULE (inside PCA plant)</u>

- A. Pipe NPS 2 and Smaller above-grade:
 - 1. Ball Valves: Two-piece, standard port, bronze with bronze trim.
 - 2. Bronze Swing Check Valves: Class 1<u>50</u>25, bronze disc.
- B. Pipe NPS 2-1/2 and Larger above-grade:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 16: 150 CWP, EPDM seat, stainless steel disc and stem
 - 2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
 - 3. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.

3.6 GLYCOL (outside PCA plant) AND CHILLED — WATER VALVE SCHEDULE (inside PCA plant)

- A. Pipe NPS 2 and smaller above-grade:
 - 1. Ball valves: Two-piece, standard port, bronze with bronze trim.
 - 2. Bronze Swing Check Valves: Class 12550, bronze disc.
- B. NPS 2-1/2 and Larger above-grade:

- 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless steel disc and stem
- 2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
- 3. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.

3.7 CONDENSER -WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller above-grade:
 - 1. Ball Valves: Two-piece, standard port, bronze with bronze trim.
 - 2. Bronze Swing Check Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger above-grade:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 14: 150 CWP, EPDM seat, stainless steel disc and stem
 - 2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
 - 3. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.

3.8 FLOW BALANCING VALVES

- A. Location: Provide flow balancing valves where indicated. The exact location shall be determined using field measurements relating to the specific piping arrangement and the manufacturer's recommendations.
- B. Manufacturer' Recommendation: Install in accordance with manufacturer's recommendations including valve orientation and increases or decreases in pipe size at points of installation, together with minimum recommended lengths of straight pipe before and after points of installation.
- C. Calibration Meter: At the conclusion of the system test and balance and prior to final completion the meter shall be turned over to, and shall become the property of, the Owner.

3.9 DRAIN VALVES

A. Location: Install drain valves at the base of all water piping risers (both supply and return) and at all low points in the piping system. Drain valves shall be fitted with schedule 80 hose connection end with cap unless otherwise indicated.

END OF SECTION 23 05 23.01

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

- This Section includes the following: Α.
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - Elastomeric hangers. 6.
 - Spring hangers. 7.
 - 8. Spring hangers with vertical-limit stops.
 - Pipe riser resilient supports. 9.
 - Resilient pipe guides. 10.
 - Freestanding and restrained air-mounting system. 11.
 - 12. Restrained vibration isolation roof-curb rails.
 - Restraining braces and cables. 13.
 - Steel and inertia, vibration isolation equipment bases. 14.
 - Braided Flexible pipe connectors. 15.
 - Neoprene Flexible Pipe Connectors. 16.
 - Grooved-joint Flexible Pipe Connectors 17.

1.3 DEFINITIONS

- IBC: International Building Code. Α.
- ICC-ES: ICC-Evaluation Service. Β.
- C. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
- D. Life Safety and Hazardous Components - All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems and

mechanical, electrical, plumbing or fire protection systems that support the operation of or are connected to emergency power equipment including all lighting, generators, transfer switches and transformers. Hazardous components include any pipe, vessel, duct or piece of equipment that contains flammable or toxic material.

- E. Component – a part or element of an architectural, mechanical, electrical or structural system.
- F. Positive Attachment – a cast in place anchor, a drill in wedge anchor, a chemical anchor, a double sided beam clamp loaded perpendicular to the beam or a welded or bolted connection to the structure.
- Special Inspection inspection of the materials, installation, fabrication or placement of G. components and anchorage.

1.4 PERFORMANCE REQUIREMENTS

- Α. Wind-Restraint Loading:
 - Values as specified from Project structural engineer and applicable code. 1.
- Β. Seismic-Restraint Loading:
 - 1. Values as specified from Project structural engineer and applicable code.

SUBMITTALS 1.5

- Α. Product Data: For the following:
 - Include rated load, rated deflection, and overload capacity for each vibration 1. isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - Tabulate types and sizes of seismic restraints, complete with report numbers a. and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - Annotate to indicate application of each product submitted and compliance b. with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
 - Catalog cuts and data sheets on specific vibration isolators and restraints to be 4. utilized showing compliance with specifications.
 - An itemized list showing the items of equipment or piping to be isolated, the isolator 5. type and model number selected, isolator loading and deflection, and reference to specific drawings showing base and construction where applicable.

- 6. restraint calculations and structural or civil engineers stamp verifying design and calculations for seismic restraining system used.
- 7. Drawings showing equipment base construction for each piece of equipment, including dimensions, structural member sizes and support point locations.
- Drawing showing methods of suspension, support guides for piping. 8.
- Drawings showing methods for isolation of pipes piercing walls and slabs. 9.
- Concrete and steel details for bases including anchor bolt locations. 10.
- 11. Number and location of restraints and anchors for each piece of equipment.
- Specific details of restraints including anchor bolts for mounting and maximum 12. loading at each location, for each piece of equipment and or pipe.
- Β. Delegated-Design Submittal: For vibration isolation details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the gualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, and wind restraints, and for designing vibration isolation bases.
 - Coordinate design calculations with wind load calculations required for a. equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes,. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Wind Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - Details: Indicate fabrication and arrangement. Detail attachments of b. restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - Coordinate vibration isolation details with wind-restraint details required for C. equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - Preapproval and Evaluation Documentation: By an agency acceptable to d. authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- Welding certificates. D.
- E. Qualification Data: For professional engineer and testing agency.
- F. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- G. Field quality-control test reports.
- Operation and Maintenance Data: For air-mounting systems to include in operation and Η. maintenance manuals.

QUALITY ASSURANCE 1.6

- Α. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Β. Welding Code - Steel."
- C. Restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support -restraint designs must be signed and sealed by a qualified professional engineer.
- D. It is the objective of this Specification to provide the necessary design for the seismic restraint and control of excessive noise and vibration in the buildings due to the operation of machinery or equipment, and/or due to interconnected piping. The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representatives.
 - 1. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation ins being provided according to the design.

- 2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50 percent above the design deflection.
- 3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as whole by more than plus or minus 10 percent.
- All neoprene mountings shall have a shore hardness of 30 to 60 plus or minus 5, 4. after minimum aging of 20 days or corresponding oven aging.

1.7 MANUFACTURER RESPONSIBILITIES

- Α. Manufacturer of vibration isolation control equipment shall have the following responsibilities:
 - 1. Determine vibration isolation restraint sizes and locations.
 - 2. Provide piping and equipment isolation systems restraints as scheduled or specified.
 - Guarantee specified isolation system deflection. 3.
 - 4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
 - Purchased and/or fabricated equipment must be designed to safely accept 5. external forces of one-half "G" load in any direction for all rigidly and resiliently supported equipment and piping without failure and permanent displacement of the equipment. Life safety equipment including, but not limited to, fire pumps, sprinkler piping, and machinery must be capable of safely accepting external forces up to one "G" load in any direction without permanent displacement of the supported equipment. Substitution of "Internally Isolated" mechanical equipment in lieu of the specified isolation of this Section must be approved for individual equipment units and is acceptable only if above accelerations are certified in writing by equipment manufacturer and stamped by a licensed civil or structural engineer.

1.8 CONTRACTOR RESPONSIBILITIES

- The Contractor performing the work on equipment in the section shall have the following Α. responsibilities.
 - 1. Identify the components that are part of the Quality Assurance Plan.
 - All electrical components for standby or emergency power systems. 2.
 - 3. All flammable, combustible and highly toxic piping and their associated mechanical systems.
 - 4 All ductwork containing hazardous materials.
 - 5. All equipment using combustible or toxic energy sources.
 - 6. Identify all Special inspection and Testing.

- List control procedures within the contractor's organization including methods and 7. frequency of reporting and their distribution.
- List personnel and their qualifications exercising control over the seismic aspects 8. of the project.
- Purchased and/or fabricated equipment must be designed to safely accept 9. external forces of one "G" load in any direction for all rigidly and resiliently supported life safety or hazardous equipment components, piping and ductwork without failure and permanent displacement of the equipment.

PART 2 - PRODUCTS

- 2.1 **VIBRATION ISOLATORS**
 - Manufacturers: Subject to compliance with requirements, provide products by one of the Α. following:
 - 1. Amber/Booth Company, Inc.
 - Kinetics Noise Control. 2.
 - 3. Mason Industries.
 - Vibration Eliminator Co., Inc. 4.
 - Vibration Mountings & Controls, Inc. 5.
 - Victaulic 6.
 - Β. Vibration Isolator Types:
 - 1. Type A: Spring isolators shall incorporate the following:
 - Minimum diameter of 0.8 of the loaded operating height. a.
 - Corrosion resistance where exposed to corrosive environment with: b
 - Springs cadmium plated or electro-galvanized. 1)
 - 2) Hardware cadmium plated.
 - All other metal parts hot-dip galvanized. 3)
 - Reserve deflection (from loaded to solid height) of 50 percent of rated C. deflection.
 - d. Minimum 1/4 inch thick neoprene acoustical base pad on underside, unless designated otherwise.
 - Designed and installed so that ends of springs remain parallel and all springs e. installed with adjustment bolts.
 - Non-resonant with equipment forcing frequencies or support structure f. natural frequencies.
 - Spring isolators to be Mason Type SLF, or as approved. g.
 - This isolator must be accompanied by seismic isolator Type II. h.
 - <u>Type B</u>: Spring isolators shall be same as Type A, except: 2.

- Provide built-in vertical limit stops with minimum 1/4 inch clearance under a. normal operation.
- Tapped holes in top plate for bolting to equipment when subject to wind load. b.
- Capable of supporting equipment at a fixed elevation during equipment C. erection. Installed and operating heights shall be identical.
- d. Adjustable and removable spring pack with separate neoprene pad isolation.
- Housing shall be designed to accept 1 G of acceleration. e.
- f. Mason Type SLR, or as approved.
- 3. <u>Type C</u>: Spring hanger rod isolators shall incorporate the following:
 - Spring element seated on a steel washer within a neoprene cup a. incorporating a rod isolation bushing.
 - Steel retainer box encasing the spring and neoprene cup. b.
 - Mason Type HS, or as approved. C.
- 4. Type E: Elastomer hanger rod isolators shall be incorporate the following:
 - Molded unit type neoprene element with projecting bushing lining rod a. clearance hole.
 - Neoprene element shall be minimum 1-3/4 inch thick. b.
 - Steel retainer box encasing neoprene mounting. C.
 - Clearance between mounting hanger rod and neoprene bushing shall be d. minimum of 1/8 inch.
 - Mason Type HD, or as approved. e.
- 5. Type F: Combination spring/elastomer hanger rod isolators to incorporate the following:
 - a. Spring and neoprene isolator elements in a steel box retainer. Neoprene of double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
 - Characteristics of spring and neoprene as describe in Type A and Type E b. isolators.
 - Mason Type 30N, or as approved. C.
- 6. Type G: Pad type elastomer mountings to incorporate the following:
 - 0.750 inch minimum thickness. a.
 - 50 psi maximum loading. b.
 - Ribbed or waffled design. C.
 - 0.10 inch deflection per pad thickness. d.
 - 1/16 inch galvanized steel plate between multiple layers or pad thickness. e.
 - f. Suitable bearing plate to distribute load.
 - Mason Type Super W, or as approved. g.
- 7. Type H: Pad type elastomer mountings to incorporate the following:

- Laminate canvas duck and neoprene. a.
- b. Maximum loading 1000 psi.
- Suitable bearing plate to distribute load. C.
- Minimum thickness. 1/2 inch. d.
- Mason Type HL, or as approved. e.
- 8. Type J: Rail type spring isolators:
 - Rail type spring isolators shall provide steel members of sufficient strength a. to prevent flexure with equipment operation.
 - b. Mason Type ICS, or equal.
- 9. Type K: Pipe anchors:
 - Vibration isolator manufacturer shall provide an all directional acoustical pipe a. anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material.
 - Vertical restraints shall be provided by similar material arranged to prevent b. vertical travel in either direction.
 - Allowable loads on the isolation material shall not exceed 500 psi and the C. design shall be balanced for equal resistance in any direction.
 - Mason Type ADA, or as approved. d.

2.2 **AIR-MOUNTING SYSTEMS**

- Manufacturers: Subject to compliance with requirements, provide products by one of the Α. following:
 - 1. Kinetics Noise Control.
 - 2. Mason Industries.
 - 3. Vibration Eliminator Co., Inc.
- Air Mounts: Freestanding, single or multiple, compressed-air bellows. Β.
 - Assembly: Upper and lower steel sections connected by a replaceable, flexible, 1. nylon-reinforced neoprene bellows.
 - 2. Maximum Natural Frequency: 3 Hz.
 - Operating Pressure Range: 25 to 100 psig (172 to 690 kPa). 3.
 - Burst Pressure: At least three times manufacturer's published maximum operating 4. pressure.
 - 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch (3 mm).
- Restrained Air Mounts: Housed compressed-air bellows. C.

- Assembly: Upper and lower steel sections connected by a replaceable, flexible, 1. nylon-reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with leveling adjustment and attachment screws.
- Maximum Natural Frequency: 3 Hz. 2.
- Operating Pressure Range: 25 to 100 psig (172 to 690 kPa). 3.
- Burst Pressure: At least three times manufacturer's published maximum operating 4. pressure.
- 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch (3 mm).

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- Manufacturers: Subject to compliance with requirements, provide products by one of the Α. following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - Mason Industries. 3.
 - Vibration Eliminator Co., Inc. 4.
 - Vibration Mountings & Controls, Inc. 5.
- Type <u>B-1</u>: Integral Structural Steel Base Β.
 - 1. Reinforced, as required, to prevent base flexure at start-up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails. Drilled for drive and driven unit mounting template.
 - Mason Type M, WF, or as approved. 2.
- C. Type B-2: Concrete Inertia Base
 - 1. Concrete inertia bases shall be formed in a structural steel perimeter base, reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment. The base shall be complete with motor slide rails, pump base elbow supports, and complete with height saving brackets, reinforcing, equipment bolting provisions and isolators.
 - 2. Minimum thickness of the inertia base shall be according to the following tabulation:

Motor Size	Minimum Thickness
(hp)	(in)
5-15	6
20-50	8
60-75	10
100-250	12
300-500	18

- 3. Mason Type K, BMK, or as approved.
- D. Type B-3: Curb Mounted Base
 - 1. Curb mounted rooftop equipment shall be mounted on spring isolation curbs that directly sit on roof construction and are flashed and incorporated into roof's membrane waterproofing system.
 - 2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal.
 - 3. All spring mounts shall be as Isolator Type B.
 - 4. Curb and spring mounting shall be capable of withstanding 110mph wind and 1.0 g seismic loads for life safety or hazardous components.
 - 5. Curbs shall be Mason Type CMAB or RSC (depending on deflection required), or approved equal.
- Ε. Type B-4: Vaneaxial Fan Built-Up Casing Floating Base
 - 1. The vaneaxial fan casing, coils, filter assembly and inlet/discharge silencers shall be erected on top of a poured-in-place, reinforced concrete floating floor supported on Mason Industries Type EAFM 2" high mounting system, or as approved.
 - 2. The mountings shall be oriented in the floating floor base for the weight and weight distribution of the supported equipment (casing, coils, filter, silencers) on the floating floor.
 - 3. The plywood form shall be Type AC exterior grade, 2", thick. Isolation mounts shall be 2", thick and shall be selected and oriented to provide deflections not exceeding 0.3" or 10 Hz frequency.
 - The fans shall be resiliently spring supported, and as described elsewhere, from 4. concrete piers erected from the structural slab and isolated from the floating floor.
 - The design and installation of the vaneaxial fan built-up casing floating floor and 5. fan isolation shall be coordinated with the vibration control vendor such that there will be no short circuit of the floating built-up casing base and the building structure.

2.4 **FLEXIBLE CONNECTORS**

- Elastomer Type FC-1: Α.
 - 1. Manufactured of nylon tire cord and EPDM both molded and cured with hydraulic presses.
 - 2. Straight connectors shall have two spheres reinforced with a molded-in external ductile iron ring between spheres.
 - 3. Elbow shall be long radius reducing type.
 - Rated 250 psi at 170 degrees F dropping in a straight line to 170 psi at 250 degrees 4. F for sizes 1-1/2 inch to 12 inch elbows. Elbows shall be rated no less than 90 percent of straight connections.

- Sizes 10 inches to 12 inches to employ control cables with neoprene end fittings 5. isolated from anchor plates by means of 1/2 inch bridge bearing neoprene bushings.
- Minimum safety factor, 4 to 1 at maximum pressure ratings. 6.
- Submittals shall include test reports. 7.
- Mason Type MFTNC Superflex. 8.
- Β. Flexible Stainless Hose, Type FC-2:
 - Braided flexible metal hose. 1.
 - 2 inch pipe size and smaller with male nipple fittings. 2.
 - 2-1/2 inch and larger pipe size with fixed steel flanges. 3.
 - Suitable for operating pressure with 4 to 1 minimum safety factor. 4.
 - Length as required or shown on drawings. 5.
 - Mason Type BSS, or as approved. 6.

Flexible Couplings, Type FC-3:

- 7. Flexible style grooved-joint couplings
- 8. 2 inch pipe size and larger
- Suitable for vibration attenuation at major equipment connections 9.
- 10. Victaulic Styles 77, 177 or W77

2.5 FACTORY FINISHES

- Finish: Manufacturer's standard prime-coat finish ready for field painting. Α.
- Manufacturer's standard paint applied to factory-assembled and -tested Β. Finish: equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - Color-code or otherwise mark vibration isolation and seismic- and wind-control 4. devices to indicate capacity range.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - Examine areas and equipment to receive vibration isolation and seismic- and wind-Α. control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

- Examine roughing-in of reinforcement and cast-in-place anchors to verify actual B. locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **APPLICATIONS**

- Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for A. application by an agency acceptable to authorities having jurisdiction.
- Β. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support -Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION-CONTROL -RESTRAINT DEVICE INSTALLATION

- Α. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- Β. Equipment Restraints:
 - Install seismic snubbers on HVAC equipment mounted on vibration isolators. 1. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - Install resilient bolt isolation washers on equipment anchor bolts where clearance 2. between anchor and adjacent surface exceeds 0.125 inch.
 - Install seismic-restraint devices using methods approved by an agency acceptable 3. to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a 2. maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- Install cables so they do not bend across edges of adjacent equipment or building D. 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.

- Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to F. provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- Η. 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.
 - Wedge Anchors: Protect threads from damage during anchor installation. Heavy-3. duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior 6. applications.

3.4 FIELD QUALITY CONTROL

- Testing Agency: Engage a qualified testing agency to perform tests and inspections. Α.
- Β. Perform tests and inspections.
- C. Tests and Inspections:
 - Provide evidence of recent calibration of test equipment by a testing agency 1. acceptable to authorities having jurisdiction.
 - Schedule test with Owner, through Architect, before connecting anchorage device 2. 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.
 - Test to 90 percent of rated proof load of device. 5.
 - Measure isolator restraint clearance. 6.
 - Measure isolator deflection. 7.

- 8. Verify snubber minimum clearances.
- Air-Mounting System Leak Test: After installation, charge system and test for 9. leaks. Repair leaks and retest until no leaks exist.
- Air-Mounting System Operational Test: Test the compressed-air leveling system. 10.
- Test and adjust air-mounting system controls and safeties. 11.
- If a device fails test, modify all installations of same type and retest until satisfactory 12. results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- Adjust isolators after piping system is at operating weight. Α.
- Adjust limit stops on restrained spring isolators to mount equipment at normal operating Β. height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

A. As scheduled on drawings or in following table.

Equipment	Base Type	lsolator Type	Minimum Static Deflection (inches)
Floor Mounted Air Handling Units	B-1	А	1.0
Floor Mounted Centrifugal Fans	B-1	А	1.0
Floor Mounted Tubular Fans	B-1	А	1.0
Ceiling Suspended Fan vent Sets		F	1.25
Ceiling Suspended Tubular Fans		F	1.25
Ceiling Suspended Centrifugal		F	1.25
Fans			
Ceiling Suspended FCU and FPB		F	1.25
Ceiling Suspended Split DX sys-		F	1.25
tem			
Ceiling Suspended Unit Heaters		F	1.25
Suspended Water Piping *		F	1.25
Pumps	B-2	В	2.5

Chillers B-1 H 0.25

* Note: All water piping within MER's, and within 50 ft of Mechanical Rooms. all piping 4 in. and larger within and/or suspended from occupied floor.

3.7 DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance Α. personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

END OF SECTION 23 05 48

SECTION 23 05 80 - AIR CONTROL AND ACCESSORIES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Basic Requirements: Provisions of Section 23 00 10 Basic HVAC Requirements are part of this Section.
- 1.2 WORK INCLUDED
 - A. Pressurized Expansion Tank
 - B. Air Separator
 - C. Manual Air Vent
 - D. High Capacity Automatic Air Vent
 - E. Automatic Air Vent
- 1.3 QUALITY ASSURANCE
 - A. Expansion tanks shall be constructed with materials and standards which comply with the following standards:
 - 1. American Society of Mechanical Engineers (ASME) Codes:
 - 2. Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1.
- 1.4 SUBMITTALS
 - A. Submit shop drawings in accordance with Division 01 requirements.
 - B. Submit schedule indicating make, model, size, etc. by system.
 - C. Submit statement of Code compliance where applicable.

D. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Pressurized Expansion Tank:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology
 - 2. Bell & Gossett
 - 3. Taco, Inc.
- B. Air Separator:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology.
 - 2. Bell & Gossett, Inc.
 - 3. Taco, Inc.
- C. Manual Air Vent:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology
 - 2. Bell & Gossett. Inc.
 - 3. Taco, Inc.
- D. High Capacity Automatic Air Vent:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology
 - 2. Bell & Gossett. Inc.
 - 3. Taco, Inc.
- E. Automatic Air Vent:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology
 - 2. Bell & Gossett. Inc.
 - 3. Taco, Inc.
- F. Engineered Expansion Fill System:
 - 1. Armstrong Pump CompanyArmstrong Fluid Technology
 - 2. PACO
 - 3. Systecon.
 - 4. VC Systems.

2.2 FABRICATION

- A. Pressurized Expansion Tank:
 - 1. Closed type, welded steel construction, ASME stamped according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1 and rated for 125 PSIG working pressure at 240°F, National Board Form U-1A attached.
 - 2. Replaceable elastomeric bladder to separate water and air.
 - 3. Tappings for system connection, remote air connection, charging valve enclosure, drain connection.
 - 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
 - 5. Tank provided with integral base mount or factory furnished saddles.
 - 6. Bolted and gasketed handhole for bladder replacement, lifting ring top and side, integral steel base ring for vertical mounting.
 - 7. Factory precharged with air to scheduled pressure.
 - 8. Factory cleaned and coated outside with prime coat of rust inhibitive paint.
- B. Air Separator:
 - 1. Tangential flow pattern, welded steel construction, ASME stamped and rated for 125 PSIG working pressure at 350°F, National Board Form U-1A attached.
 - 2. Connections for system inlet and outlet, expansion tank, drain.
 - 3. Perforated stainless steel air collector tube.
 - 4. All acceptable manufactures to submit on an air separator without a strainer.
 - 5. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
 - 6. Constructed and stamped in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
 - 7. Coalescing media.
 - 8. Available with or without removable cover.
 - 9. Threaded connection up to 2 inch (DN 50) and flanged connection for larger than 2 inch (DN 50).
 - 10. Tank with drain plug and automatic leak free vent.
- C. Manual Air Vent: Hydroscopic air valve, manual shutoff valve thumb screw actuator.
 - 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.
- D. High Capacity Automatic Air Vent: Cast iron body and bolted bonnet, threaded connection stainless steel and brass internals, composition disc, pilot operated, snap action, high capacity, instant non-modulating venting thru full range of 2 psi thru 150 psi with backflow

prevention to prevent air from entering the system should pressure drop below atmospheric. Rated at 150 psi and 240°F.

- E. Automatic Air Vent:
 - 1. Body: Bronze or cast iron.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Noncorrosive metal float.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/4.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 240 deg F.
- F. Engineered Expansion System:
 - 1. The expansion system shall be a complete factory fabricated and tested package requiring, one electrical connection point, one suction connection, one discharge connection.
 - 2. The expansion system shall be a constant flow, constant pressure, skid mounted pumping unit with pumps as scheduled and a 900 Gallon atmospheric makeup storage tank.
 - 3. Structural Frame: All components shall be mounted on a structural steel base suitable for grouting. The base shall be large enough to support the packaged pumping systems pumps, piping and control panel(s). Steel supports shall be welded to the base to support the piping and control panel(s). Both the base and supports shall consist of structural steel components, all welded per the AISC Manual of Steel Construction, Part 4, "Welded Joints". The entire assembly shall be primed and painted with two coats of machine enamel after fabrication.
 - 4. Pumps shall have a continuously rising curve from minimum head to shut off condition and shall have a motor installed that is suitable for the full range of the published performance curve. All hydraulic components shall be manufactured from Type 316 stainless steel. Each impeller shall be fitted with a Teflon® seal ring. The 316L stainless steel shaft shall be fitted with Tungsten Carbide intermediary bearing(s). The mechanical seal shall be suitable for the full pressure and temperature range of the pump and shall be fitted with Carbon rotating face and Silicon Carbide stationary face. The motor pedestal shall be fitted with an oversize thrust bearing. The thrust bearing must be connected to the adapter and shaft coupling in such a manner as to eliminate pump axial loads from the motor, allowing standard NEMA design motors to be used. The thrust bearing will also remove the necessity for adjustments of any other moving part during the pump life cycle. The base mounted pump shall be assembled in a vertical shaft configuration with the suction and discharge connections being in-line at the bottom. Suction and discharge connections shall have same size flanges drilled for ANSI 125 rating. Supply a Premium Efficiency NEMA design 2-pole motor with

the electrical characteristics and enclosure as indicated on the drawings.

- 5. Suction and Discharge Manifold Piping and Specialties:
 - a. The package piping shall consist of fabricated welded Type 304 stainless steel or galvanized steel headers using manufactured fittings conforming to ASME Code B.31.1. Saddle welded or fish mouth joints shall not be acceptable. The suction and discharge connections for the system shall be field reversible by removal of a blind flange or pipe cap and shall be ANSI Class, 150 flange or grooved end connection as sized on the documents. All piping for the system shall be sized for a maximum velocity of 8 feet per second with no greater head loss per 100 feet of pipe than 4 feet. Branch piping to the pumps shall be sized for the design capacity of the pump. Base mounted supports shall be provided for the suction header, the suction and discharge piping on each pump and the discharge header. Piping shall be supported independently of pump connections. Pipe supports welded directly to the pipe are not acceptable.
 - b. Butterfly valves shall be furnished on the suction and discharge of each pump. Valves shall be constructed per Specification Section 230523 – General Duty Valves for HVAC Piping..
 - c. A spring-loaded check valve shall be installed on the discharge of each pump. Valve shall be constructed per Specification Section 230523 – General Duty Valves for HVAC Piping.
 - A suction strainer shall be installed in the main suction piping prior to any pump suction connection and shall be constructed per Specification Section 232116
 HydronicPiping Specialties.
 - e. Pressure gauges, 4-1/2" diameter complying with Specification Section 230519

 Meters and Gauges for HVAC Piping Specialties shall be furnished and mounted on the control cubicle for indication of all individual pump discharge pressures and all common suction and discharge pressures. All control sensing lines and gauge connections shall be piped with ball style shut-off valves and fitted with piston style impulse snubbers to prolong gauge life. Gauges shall be mounted such that they can be viewed from the front of the control enclosure.
- 6. Power and Control Panel:
 - f. The power and control enclosure shall be of multiple compartment construction. A single main incoming power lugs with overcurrent protection shall be housed in a dedicated compartment, and pump sequencing controls shall be housed in a separate dedicated compartment. Panels constructed with barriers or partitions are unacceptable. An across the line motor starter

shall be furnished for each pump. Power supply shall be 460 volt, 3 Ph, 60 Hz, as scheduled.

- g. The sequencing controls compartment shall include:
 - 1. Disconnect switch.
 - 2. Control circuit transformer 480/120 or 480/24 as determined by the manufacturer with primary and secondary fuses.
 - 3. System hand-off-auto switch with provisions for remote system start/stop.
 - 4. System initialized light.
 - 5. Hand-off-auto switch for each pump.
 - 6. Run light for each pump, low voltage LED style.
 - 7. Pump failure alarm light (low voltage LED style) and reset pushbutton.
 - 8. Lead pump selector switch for manual alternation of pumps.
 - 9. Make-Up Tank High Level pilot light, LED style.
 - 10. Make-Up Tank Low Level pilot light, LED style.
 - 11. High System Pressure pilot light, LED style.
 - 12. Low System Pressure pilot light, LED style.
 - 13. Necessary interface to the building automation system.
 - 14. Elapsed run time meter.
 - 15. Contact output for remote run indication.
 - 16. Contact output for remote failure indication.
 - 17. Input signal for remote setting of discharge pressure setpoint.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install in accordance with manufacturers written instructions.
- B. Install air vents at all high points of system to facilitate air removal for proper flow and heat transfer.
- 3.2 INSTALLATION
 - A. Pressurized Expansion Tank:
 - 1. Isolate tank from system during system flushing and cleaning operations.
 - 2. Vent excess air from tank prior to system heat-up.
 - 3. Ensure that tank is properly charged with air at start of warranty period.
 - 4. Install automatic air vent and pressure gauge at inlet.
 - 5. Provide equipment tag indicating required charging pressure.
 - 6. Provide drain valve and hose bibb adaptor.
 - B. Air Separator:
 - 1. Support independently of connecting piping.
 - 2. Install tap size union and gate valve with locking hand wheel in line to expansion tank.
 - 3. Install full tap sized nipple, ball valve and plug for drain valve assembly.
 - C. Manual Air Vent:
 - 2. Allow access.
 - 3. Install manual air vent on air chamber when used on system high points and where continuous venting may be coincided.
 - 4. Construct air chamber from:
 - a. 1/2" x 2" thread reducer.
 - b. 2" x 0'-4" nipple.
 - c. 1/4" x 2" thread reducer.
 - d. 1/4" x 1/8" brass bushing.
 - 4. Manual air vent.
 - 5. Provide manual air vent on all high points. Where high point will be concealed, route vent to nearest accessible location.
 - 6. In lieu of the manual air vent assembly a pressure and temperature test port may be used to vent air when used with the master air vent tool supplied with the pressure and temperature test kit specified in Section 23 05 19.
 - D. High Capacity Automatic Air Vent:

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- 1. Install where shown on drawings or standard details.
- 2. Install 1/2" ball valve and nipple between automatic air vent and system.
- 3. Provide proper access.
- 4. Do not install automatic air vent in concealed or non-accessible areas or where leakage may cause damage.
- 5. Pipe discharge to nearest floor drain.
- E. Automatic Air Vent:
 - 1. Install where shown on drawings or standard details.
 - 2. Install 1/2" ball valve and nipple between automatic air vent and system.
 - 3. Provide proper access.
 - 4. Do not install automatic air vent in concealed or non-accessible areas or where leakage may cause damage.
 - 5. Pipe discharge to nearest floor drain.

END OF SECTION 23 05 80