

SECTION 220501 – SAFINGS

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 QUALITY ASSURANCE

- A. All material shall be marked with type and grade.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new unless noted otherwise.

2.2 SAFINGS

- A. Four (4) pound sheet lead, FS QQ-L-201.
- B. Chlorinated polyethylene (CPE) as manufactured by the Noble Company under the trade name Chloraloy 240.
- C. Laminated asphaltic membrane of 8 plies kraft paper and 7 layers of asphalt, reinforced with fiberglass and polyethylene facing manufactured under the trade name Compotite.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install safing for all floor drains. Extend safing to 18 inches from edge of drain. Safing shall be clamped to floor drain body and pitched to drain to weep holes. Floor drains installed on grade do not require safing.

3.2 FIELD QUALITY CONTROL

- A. Safings shall be subject to a standing water test to detect leaks and proper drainage to weep holes of floor drain.

END OF SECTION 210500

SECTION 220510 – PLUMBING DEMOLITION AND ALTERATIONS

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. Disconnection of plumbing equipment in selected portions of building or structure.
- 2. Demolition and removal of selected plumbing components.
- 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Division 01 Section "Cutting and Patching."
- 2. Division 02 Section "Selective Structure Demolition" for sequencing and scheduling procedures and requirements for demolition activities.

1.3 JOB CONDITIONS

- A. Perform all demolition as needed to accomplish new work.
- B. Do not rely solely on plumbing drawings to determine extent of general construction demolition. Refer to architectural demolition plans for the exact extent of general construction demolition required by this contract.
- C. This Contractor is responsible for all charges, fees etc. incurred as a result of the plumbing portion of the demolition.
- D. Prior to demolition or alteration of structures, the following shall be accomplished:
 - 1. Review available record documents of the existing construction. Owner does not guarantee that existing conditions are same as those indicated in record documents.
 - 2. Coordinate sequencing with Owner and other Contractors.
 - 3. Coordinate means to separate construction zones from non-renovated zones to prevent the spread of dust, fumes and debris.
 - 4. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.
 - 5. Equipment noted to be removed and turned over to the Owner, shall be delivered to the Owner at a place and time he so designates.
 - 6. Where the materials are to be turned over to the Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain the condition of the materials and equipment equal to that existing before work began. Damaged materials or equipment shall be repaired or replaced at no additional cost to the Owner.

7. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again, and restore existing facilities to their pre-demolition condition, at no additional cost to Owner.
8. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Existing plumbing equipment in conflict with new construction shall be removed and/or relocated as indicated on the drawings, as directed or needed. This Contractor shall remove all plumbing equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. All plumbing components shall be stored on site for Owner assessment. Any components not retained by the Owner shall be removed by the contractor. Properly dispose or remove from site any items not retained by Owner.
- B. Any existing services or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction, shall be reconnected in an approved manner. Provide temporary pipes, controls, etc., as needed to prevent interruption of service to occupied areas caused by demolition operations. In addition, any piping, fixtures, or equipment which may require relocation or rerouting as a result of construction, shall be considered a part of the work of this section and shall be done by this Contractor with no additional compensation, provided that the referenced relocation is discernable from the pre-bid review of the site, and associated documents.
- C. This Contractor shall remove all fixtures, piping, hangers, and existing equipment, being discontinued or removed due to construction. Abandoned or removed services shall be disconnected and capped at the perimeter of the project or as required elsewhere in the documents. Piping shall be capped with the same or compatible piping material. Piping being abandoned in place shall be drained.
- D. The existing building is to remain in operation during construction. This Contractor shall coordinate all work that will interfere with the present operation of the facility with the Owner and Construction Manager.
- E. All existing equipment that is to remain shall be cleaned inside and out. Clean all pipeline strainer baskets and return to original condition or replace with new baskets. All dirt, plaster dust and other foreign matter shall be blown and/or cleaned from all equipment. Touch up paint on equipment in exposed areas.
- F. Equipment being removed shall be disconnected and have the services capped.
- G. Equipment being removed and reinstalled shall be disconnected, have the services capped, remove, clean and store the equipment until appropriate the reinstalled, connected and made operational.

- H. Equipment being removed and salvaged shall be disconnected and have the services capped. The equipment shall then be turned over to the owner.
- I. Plumbing fixtures indicated to remain shall be wiped clean on all surfaces to remove all dirt, plaster dust or other foreign materials.
- J. All coring that is required for plumbing work shall be done by this Contractor.
- K. All cutting and patching required for plumbing work shall be by this Contractor.
- L. This Contractor shall provide required additional support for existing piping in remodeled area that is not being removed and is not properly supported.
- M. When existing piping or related equipment in remodeled areas prevents the installation of other work, remove and reinstall existing materials, making necessary modifications and transitions to coordinate with other trades.
- N. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 CLEANING AND REPAIR

- A. Clean existing materials and equipment which remain or are to be reused. Report damage or defects to Architect

3.3 TESTING

- A. Existing equipment shall be tested before demolition begins to determine existing operating conditions and capacities. Upon completion of all new work, the existing equipment shall be tested to ensure correct operation.

END OF SECTION 220510

SECTION 220513 - COMMON MOTOR AND ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, and squirrel-cage induction motors for use on alternating current power systems up to 600V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 SUBMITTALS

- A. Submit shop drawings for all motors, including manufacturer, motor rpm, full load efficiency, full load power factor, service factor, and frame type.

1.4 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
- B. Provide all motors, power transformers, control power transformers and all electrically powered or electrically controlled equipment.
- A. All starters, disconnects, relays, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment shall be furnished by Division 22 contractor, except as specifically noted elsewhere in these specifications. Where starters and disconnects are furnished by Division 22 Contractor, they shall be installed by Division 26 Contractor, coordinated with Division 26 Contractor, connected by Division 26 Contractor, and furnished in accordance with Division 26 Sections of the specifications.
- B. Coordinate minimum AIC ratings with Division 26 drawings for Division 22 supplied starters and variable frequency drives.
- C. Drawings and/or specifications show number and horsepower rating of all motors, together with their actuating devices. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after the contracts are awarded, Division 22

Contractor is to immediately notify General Contractor of change. Any additional costs due to these changes shall be the responsibility of Division 22 Contractor.

- D. Division 26 Contractor will provide power wiring to starter, disconnect and motor and connect all equipment complete and ready to operate. Division 22 Contractor shall provide all control wiring line and low voltage, including associated conduit for all control wiring.
- E. Wire all equipment associated with this contract, including interlock wiring, except wiring which is scheduled to be done by others.
- F. Provide wiring diagrams to Division 26 Contractor for all apparatus indicating external connection and internal controls.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.
- D. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque, or any other special type as required by the manufacturer's recommendations.
 - 1. Furnish ODP Motors for indoor non-hazardous environments.
 - 2. Furnish Inverter Duty motors for all application connected to variable frequency drives as specified in this section.
 - 3. Furnish motors with splash proof or weatherproof housing where required or recommended by the manufacturer.
 - 4. Furnish TEFC or TENF motors for outdoor installation.
 - 5. Furnish Severe Duty motors complying with IEEE-841 standards or severe duty and hazardous locations.
- E. Motor enclosures shall be of the type recommended by the equipment manufacturer for the specified application.
- F. All motors shall be furnished for starting in accordance with utility requirements, and shall be compatible with starters, as specified hereinafter, or under Division 26 of the specifications.

2.2 MOTOR CHARACTERISTICS

- A. Refer to the equipment schedules and specification sections for specific voltages required.
- B. All motors shall be 1750 RPM, unless otherwise noted.
- C. Motors 1-1/2 horsepower and larger shall be premium efficiency, unless otherwise noted.

- D. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Permanently lubricated and sealed antifriction ball bearings or sleeve bearings suitable for radial and thrust loading. Motors 1/8 HP and below may be shaded pole type with permanently oiled unit bearings.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.4 STARTERS AND DISCONNECTS

- A. Furnish starters in accordance with Division 26 Specifications.
- B. Furnish disconnect switches in accordance with Division 26 Specifications.
- C. Unless otherwise indicated, reduced voltage starters to be autotransformer type.
- D. Equipment control power transformers shall have the required primary and secondary voltage and be of adequate size for equipment served.
- E. AIC Ratings:
 - 1. All starters and adjustable frequency drives (AFD/VFD) furnished by Division 22 shall comply with minimum amps interrupting current (AIC) rating as identified on Division 26 drawings and specifications. Where furnished equipment does not meet these minimum ratings requirements by itself, then a UL series rating can be used by providing a UL recognized fuse or circuit breaker located upstream of starter or VFD in accordance with UL distance limitations. Division 22 Contractor is responsible for providing any additional fusing or circuit breakers to meet the minimum AIC requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with details, approved shop drawings, and manufacturer's instructions.

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose packless expansion joints.
 - 2. Metal-bellows packless expansion joints.
 - 3. Rubber packless expansion joints.
 - 4. Grooved-joint expansion joints.
 - 5. Pipe loops and swing connections.
 - 6. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

- 1. Available Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Metraflex, Inc.
- 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
- 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
- 4. Expansion Joints for Copper Tubing NPS 4 (DN 100) and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and double-braid bronze sheaths.
- 5. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Stainless-steel fittings with threaded end connections.
- 6. Expansion Joints for Steel Piping NPS 2-1/2 and larger (DN 65 and larger): Stainless-steel fittings with flanged end connections.

B. Metal-Bellows Packless Expansion Joints:

- 1. Available Manufacturers:
 - a. Adscos Manufacturing LLC.
 - b. Flexicraft Industries.
 - c. Metraflex, Inc.
- 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- 3. Type: Circular, corrugated bellows with external tie rods.
- 4. Minimum Pressure Rating: 150 psig (1035 kPa) unless otherwise indicated.
- 5. Configuration: Single joint class unless otherwise indicated.
- 6. Expansion Joints for Copper Tubing: Multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.

C. Rubber Packless Expansion Joints:

- 1. Available Manufacturers:

- a. Flexicraft Industries.
 - b. Flex-Weld, Inc.
 - c. Metraflex, Inc.
2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
 4. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
 5. Material for Water: EPDM.
 6. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 GROOVED-JOINT EXPANSION JOINTS

A. Manufacturers:

1. Anvil International, Inc.
2. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Couplings: Flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Available Manufacturers:

- a. Adscos Manufacturing LLC.
- b. Flexicraft Industries.
- c. Metraflex, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.
- D. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Available Manufacturers:
 - 1. Terice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Winters Instruments
- B. Thermometers shall be 5 inch (125 mm), round bi-metal type, stainless steel case, readable scale and gradations from 30 degrees F. to 240 degrees F. (0 degrees C. to 115 degrees C.), external calibrator adjustment, back or bottom connection as appropriate. Provide brass

extension neck sockets of appropriate length. Thermometers shall be equal to Terice Series #B85200.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Available Manufacturers:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments
2. Thermometers shall be 9 inch (225 mm), die cast aluminum case, double strength glass window, adjustable angle stem, lens, front reading mercury tube, readable scale with gradations from 30 degrees F. to 240 degrees F. (0 degrees C. to 115 degrees C.). Provide brass extension neck sockets of appropriate length. Thermometers shall be equal to Terice Series #BX91400.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Bore Diameter and Insertion length: Required to match thermometer bulb or stem.
4. Lagging Extension: Include on thermowells for insulated piping and tubing.
5. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Available Manufacturers:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments
2. Pressure gauge shall be 4-1/2 inch (115 mm) die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 psi to 200 psi (0 bar to 14 bar) phosphor bronze bourdon tube, stainless steel movement. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #500X.
3. Pressure gauge shall be 3-1/2 inch (90 mm) die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 psi to 200 psi (0 bar to 14 bar), phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #600.
4. Pressure gauge shall be 3-1/2 inch (90 mm) stainless steel case, glass window, readable dial scale with gradations from 0 psi to 200 psi (0 bar to 14 bar), phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #890.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in pipe tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install pressure gages in piping tees with gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- I. Install pressure gages in the following locations:
 - 1. Suction and discharge of each domestic water pump.
- J. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- K. Adjust faces of meters and gages to proper angle for best visibility.
- L. Thermometers and pressure gauges shall be any of the respective items listed in the above sections.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 ACTION SUBMITTALS

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

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. 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.

- B. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or soldered.
 - g. Seats: PTFE or TFE.

- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded or soldered.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

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

1. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.

d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers:

- a. Crane Co.; Crane Valve Group;
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

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:

- a. Crane Co.; Crane Valve Group;
- 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.

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. Where piping is more than 48" (1,200mm) above an accessible ceiling, provide a drop in the pipe to bring the valve to within 48" (1,200mm) of the ceiling.
- 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 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.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Ball or butterfly valves.
4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.

B. Valve pressure ratings shall be no less than the system pressure for any application. 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 (DN 50) and Smaller: Threaded or soldered ends.
2. For Copper Tubing, NPS 2-1/2 (DN 65) and larger: Flanged ends.
3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 (DN 65) and larger: Flanged ends
5. For Grooved-End Copper Tubing: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball Valves: Two piece, full port, bronze with brass or stainless-steel trim.
2. Bronze Swing Check Valves: bronze disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe positioning systems.
9. Equipment supports.

- B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.
5. Division 22 Section "Seismic Restraint for Plumbing Piping and Equipment" for requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for shop and field fabricated pipe and equipment support systems.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.
3. Grinnell Corp.
4. Hubbard Enterprises/Holdrite
5. Tolco Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

C. Stainless-Steel Pipe Hangers and Supports:

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

D. Copper Pipe Hangers:

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

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

1. The total weight of piping and components upon each trapeze span shall not exceed the manufacturers load rating. Load ratings must include a minimum 2 X safety factor.
 - a. Hubbard Enterprises/HOLDRITE EZ-Strut™ or owner approved equivalent.

2.3 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Seasafe, Inc.
 - c. Unistrut Corp.; Tyco International, Ltd.
 - d. Wesanco
- B. Strap-Type, Fiberglass Pipe Hangers:
 1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. Tolco Inc.
 4. Unistrut Corp.; Tyco International, Ltd.
- C. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- D. Standard: Comply with MFMA-4.
- E. Channels: Continuous slotted steel channel with inturred lips.
- F. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- G. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- H. Coating: Zinc.

2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Cope, T. J., Inc.; Tyco International Ltd.
3. Seasafe, Inc.

B. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

1. Channels: Continuous slotted fiberglass channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers:

1. ERICO/Michigan Hanger Co.
2. Pipe Shields, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Stainless anchors shall be used in exterior or corrosive interior applications.

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Hilti, Inc.
- c. ITW Ramset/Red Head.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.

2.9 EQUIPMENT SUPPORTS

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

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Use hangers and supports with galvanized, metallic coatings for piping and equipment exposed to weather/moisture and that will not have field-applied rust preventative finish.
- B. Comply with MSS SP-69 for pipe hanger and support selections and applications that are not specified in piping system Sections.
- C. Plastic coated or copper-plated hangers shall be provided for copper piping in direct contact with hangers. Use padded hangers for piping that is subject to scratching.
- D. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
- E. Comply with MFMA-102 for all metal framing system selections and applications.
- F. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods are not allowed.
- G. Comply with CISPI Designation 310-04, CISPI Designation 301-09 and the CISPI Cast Iron Soil Pipe Handbook, regarding auxiliary support for no-hub cast iron pipe and fitting joints subjected to excessive thrust forces. Use manufactured assemblies with appropriate thrust pressure ratings, rather than field assembled miscellaneous materials.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled framing system.
- F. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 2. Wedge anchors are only permitted for branch piping support. Mains shall be supported from building structural members.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, backing plates and other accessories.
- I. Comply with mounting and anchoring requirements for seismic installations.
- J. All vertical risers shall be supported at each floor with riser clamp.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, strainers, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

- O. Insulated Piping shall be provided with MSS SP-58, Type 40, protective shields and Type 39 protective saddles. Shields shall span an arc of 180 degrees.
 - 1. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - 2. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
 - 3. Hangers shall be installed outside on insulated piping with protection for insulation provided by shields or saddles. Shields or saddles shall be sized to prevent depression of insulation as recommended by insulation manufacturer. However insulated drainage pipe shall have the hanger support on the pipe to insure proper pitch.
- P. No-hub pipe and fitting coupling joints that are exposed to thrust pressures greater than those recommended by the pipe and fitting manufacturer shall receive auxiliary support by means of appropriate bracing materials, as referred to in CISPI Designation 310-04, CIPSI Designation 301-09 and the CISPI Cast Iron Soil Pipe and Fittings Handbook. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation and shall be installed onto horizontal joints NPS 4 (DN 100) diameter and larger in size. Field devised methods and materials shall not be used to accomplish this application solution.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

- A. Touch Up: Clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 SPACING

- A. Refer to individual piping sections for spacing requirements.
- B. Where no requirement is specified elsewhere, pipe hangers and supports shall be per MSS SP-90
- C. The following chart shall be used for hanger spacing:

<u>Pipe Size</u>	<u>Max. Span in Feet</u>							<u>Rod Dia.</u>
	<u>CPVC</u>	<u>Copper</u>	<u>Steel</u>	<u>PVC</u>	<u>HDPE</u>	<u>CSST</u>		
1/2"	3'	6'	6'	4'	30"	6'	3/8" (10mm)	
3/4"	3'	6'	8'	4'	34"	6'	3/8" (10mm)	
1"	3'	6'	8'	4'	39"	6'	3/8" (10mm)	
1-1/4"	4'	6'	8'	4'	43"	6'	3/8" (10mm)	
1-1/2"	4'	6'	10'	4'	49"	6'	3/8" (10mm)	
2"	4'	10'	10'	4'	55"	6'	3/8" (10mm)	
2-1/2"	4'	10'	12'	4'	96"	N/A	1/2" (13mm)	
3"	4'	10'	12'	4'	96"	N/A	1/2" (13mm)	
4"	4'	10'	12'	4'	96"	N/A	5/8" (13mm)	
5"	4'	10'	12'	4'	N/A	N/A	5/8" (16mm)	
6"	4'	5'	6'	4'	N/A	N/A	3/4" (19mm)	
8" and larger	4'	5'	6'	4'	N/A	N/A	7/8" (22mm)	

- D. Cast iron soil piping shall be supported every 5 feet and at all fitting locations. Vertical piping shall be supported every 15 feet. Rod diameter shall be as equal to that listed for each size in the chart above.

END OF SECTION 220529

SECTION 220700 - 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
 - 2. Adhesives.
 - 3. Mastics.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Field-applied fabric-reinforcing mesh.
 - 7. Field-applied cloths.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
 - 11. Protective Shielding Guards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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 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.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. All insulation materials furnished shall meet the minimum thickness requirement of ASHRAE standard 90.1.
- E. Insulation materials for use on stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Type 'R': Rigid (Molded) Fibrous glass, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Insulation without factory applied jacket shall be used in locations where field applied jackets are specified.
 - 2. Products:
 - a. Owens Corning; Fiberglas Pipe Insulation SSL II-ASJ
 - b. Johns Manville; Micro-Lok
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid 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.
 - 1. Products:
 - a. Johns Manville; MicroFlex.
 - b. Knauf Insulation; Pipe and Tank Insulation.
 - c. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products:
 - a. Aeroflex USA Inc.; Aeroseal. (VOC: 417 g/L)
 - b. Armacell LCC; 520 Adhesive. (VOC: 430 g/L)
 - c. Foster Products, H. B. Fuller Construction Products; 85-75. (VOC: 7 g/L)

- C. Mineral-Fiber and ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

- a. Childers Products, H.B. Fuller Construction Products; CP-127. (VOC: 5 g/L)
- b. Foster Products, H. B. Fuller Construction Products; 85-20 or 85-60. (VOC: 168 g/L or 4 g/L)
- c. Mon-Eco Industries, Inc.; 22-25. (VOC 1,109 g/L)

- D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

- a. Dow Chemical Company; 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. Speedline Corporation; Polyco VP Adhesive.

2.3 COATINGS/MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II and be QPL listed.

- B. Vapor-Barrier Coating: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

- a. Childers Products, H.B. Fuller Construction Products; CP-38.
- b. Foster Products, H. B. Fuller Construction Products; 30-80.
- c. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E96/ E 96M Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

- a. Childers Products, H.B. Fuller Construction Products; CP-10/CP-11.
- b. Foster Products, H. B. Fuller Construction Products; 46-50.

2. Water-Vapor Permeance: ASTM F1249, 1.8 perm (1.2 metric perm) at 0.0625 inch (1.6 mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products:
 - a. Childers Products, H.B. Fuller Construction Products; CP-76 or CP-70. (VOC: 356 g/L and 85 g/L)
 - b. Foster Products, H. B. Fuller Construction Products; 30-45 or 95-50. (VOC: 87 g/L and 380 g/L)
 - c. Pittsburgh Corning Pittseal 444 (VOC: 98 g/L)
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

B. Metal Jacket Flashing Sealants:

1. Products:
 - a. Childers Products, H.B. Fuller Construction Products; CP-76 or CP-70. (VOC: 356 g/L and 85 g/L)
 - b. Foster Products, H. B. Fuller Construction Products; 95-44 or 30-45. (VOC: 384 g/L and 87 g/L)
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, H. B. Fuller Construction Products; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 9 strands by 8 strands/sq. in., in a Leno weave, for pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Products, H. B. Fuller Construction Products; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.7 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, ; roll stock ready for shop or field cutting and forming thickness as scheduled.
 1. Products:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 4. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 2. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 3. 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, Tee covers, Flange and union covers, End caps, Beveled collars, Valve covers.
 - c. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

1. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
2. Material, finish, and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
4. 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, Tee covers, Flange and union covers, End caps, Beveled collars, Valve covers.
 - c. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
- 2. Width: 2 inches (50 mm).
 - 3. Thickness: 3.7 mils (0.093 mm).
 - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

- 1. Manufacturers:
 - a. McGuire Manufacturing.
 - b. Plumberex.
 - c. Truebro; a brand of IPS Corporation.
 - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
- 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 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. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.
- 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. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) oc.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) oc.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- N. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions while complying with firestopping requirements.
- E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Tank and Vessel Insulation Installation: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) oc 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 and vapor barrier mastic 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 (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) oc. 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 (1200 mm) oc. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches (75 mm).
 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.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, 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. 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 manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. 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.

F. 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.

3.6 FLEXIBLE ELASTOMERIC AND FIBERGLASS INSULATION INSTALLATION

- A. Elastomeric Insulation: Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Fiberglass Insulation: Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) oc.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive and seal with vapor-barrier mastic and flashing sealant.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant. Secure jacket with stainless-steel bands 12 inches (300 mm) oc and at end joints.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections. Paint two coats with a flat acrylic finish over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 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 equipment in paragraphs below that is not factory insulated.
- C. Domestic water insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
 - 2. Mineral-Fiber: 1 inch (25 mm) thick.
- D. Domestic Hot-Water Storage Tank Insulation: Mineral-Fiber Pipe and Tank: Of thickness to provide an R-value of 12.5.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. 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. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

C. All piping and equipment shall be insulated per the table below:

Service	Insulation Type	Insulation Thickness According to Pipe Size			
		1/2" – 3/4"	1" – 2"	2-1/2" – 4"	6" and Larger
Storm Water (drain body and horizontal piping only)	R	1	1	1	1
Condensate	R	1	1	1	1
Below Grade/Slab Hot Water and Hot Water Return	CC	1	1-1/2	1-1/2	1-1/2
Above Grade/Slab Hot Water and Hot Water Return	R	1	1	1-1/2	1-1/2
All Pipe In Exterior Walls	CC	1	1	1	1
Cold water in unconditioned spaces.	CC	1	1	1	1
Cold Water	R	1	1	1	1
Sanitary PVC piping above Hotel Room Ceilings	A	-	1	1	1
Sanitary/Grease Piping with Heat Trace	CC	-	3	3	3
Pipe in Mechanical Rooms	RJ	The insulation thickness shall be as stated in this chart depending on service and pipe size.			
Exterior Above Ground Water Piping	CC	2	2	2	2
Piping on roof	UV	1	1-1/2	1-1/2	1-1/2

3.11 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. Equipment, Concealed: None.
- C. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - 1. PVC: 30 mils (0.8 mm) thick.
 - 2. Aluminum, Smooth: 0.032 inch (0.81 mm) thick.
- D. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
 - 1. Aluminum, Smooth or Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.032 inch (0.81 mm) thick.
- E. Piping, Concealed: None.
- F. Piping, Exposed:

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth or Stucco Embossed: 0.016 inch (0.41 mm) thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Domestic water piping and fittings inside the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following products:
 - 1. Piping materials including joining materials/methods.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

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:

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper, for above ground applications. Below ground applications shall be ASTM B 88, Type K (ASTM B 88M, Type A) water tubing.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers:
 - 1) Elkhart/Apollo Xpress
 - 2) NIBCO Inc.
 - 3) Viega; Plumbing and Heating Systems, Pro-Press.
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with factory installed EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with factory installed EPDM-rubber O-ring seal in each end.
 - d. Press ends shall have a designed leakage path. In 1/2" to 4" dimensions, the feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
 6. Copper-Tube Extruded-Tee Connections:
 - a. Manufactured by T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
 7. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufactured by Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts, with a minimum pressure rating of 300 psig (2070 kPa).
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Copper Pressure-Seal-Joint Fittings as stated in Hard Copper tubing above.

2.3 PIPING JOINING MATERIALS

- A. Refer to Section 220500 for materials common to multiple specification sections.

2.4 COPPER PIPE SLEEVE

- A. Material: 10 mil Polyethylene sleeve for protection in concrete pour.
 - 1. Piping shall be cleaned prior to installation. Extend sleeve 6" (15cm) above floor level. Tape ends shut to prevent entry of debris.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, and pressure gage, inside the building at each domestic water service entrance.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping 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, and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install piping to permit valve servicing.
- H. 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.
- I. Install piping free of sags and bends.
- J. Install unions at final connection to each piece of equipment, machine, and specialty. Install shut-off valves on the upstream side of the upstream union and downstream of the downstream union on each piece of equipment.
- K. The system installation shall include all connections to plumbing fixtures, each piece of equipment and all equipment furnished under other contracts.
- L. Piping shall be installed with necessary swing joints and offsets to properly allow for expansion in addition to expansion joints. Provide dielectric unions between steel and copper connections when copper pipe is installed.
- M. Install all water pipe by use of proper pipe and fitting materials. All changes in pipe size shall be by use of reducing fittings. Bushings shall not be used.
- N. All hot water systems shall be balanced by the contractor to ensure proper flow through each recirculating leg of the system including all mains back to the recirculation pump.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel and CPVC pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- 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.
- I. 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.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 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.
- C. Piping tests shall be performed per the requirements of the authority having jurisdiction. If the AHJ has no specific requirements, perform the following at a minimum:
 - 1. Flush all piping prior to testing.
 - 2. Fill domestic water piping with water. Check components to determine that they are not air bound and that piping is full of water.

3. 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.
4. 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.
5. Cap and subject piping to static water pressure of 100 psig (690 kPa) above operating pressure, without exceeding pressure rating of piping system materials for 24 hours. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
6. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
7. Prepare reports for tests and for corrective action required.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open throttling valves to proper setting.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Adjust calibrated balancing valves to flows indicated.
 - b. Provide a separate balancing report indicating the adjusted water balance flows.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.5 CLEANING

A. Clean and disinfect domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.6 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- C. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Water mixing valves.
 - 5. Strainers.
 - 6. Outlet boxes.
 - 7. Hose stations.
 - 8. Drain valves.
 - 9. Water hammer arresters.
 - 10. Air vents.
 - 11. Vacuum relief valves
 - 12. Trap-seal primer valves.
 - 13. Flexible connectors.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.
 - 3. Division 22 Section "Water Filtration Piping and Equipment" for water filters in domestic water piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers shall meet ASSE 1001 and shall have a bronze body construction, size to match adjacent piping:
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- B. Hose-Connection Vacuum Breakers shall meet ASSE 1011 and be a bronze body with garden house thread outlet:
 - 1. Manufacturers: Watts Industries, Woodford, Wilkins.
- C. Pressure Vacuum Breakers shall meet ASSE 1020, shall have a bronze body and shall be for use in continuous pressure applications and shall be provided with ball type shutoff valves on the inlet and outlet:
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- D. Laboratory-Faucet Vacuum Breakers shall meet ASSE 1035, chrome plated bronze:
 - 1. Manufacturers: Apollo Valve, Watts Industries, Woodford, Wilkins.
- E. Spill-Resistant Vacuum Breakers shall meet ASSE 1056, bronze body, rated for continuous pressure application and be provided with ball valves on the inlet and outlet:
 - 1. Manufacturers: Apollo Valve, Watts Industries.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers shall meet ASSE 1012 with bronze body, for continuous pressure applications:
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- B. Reduced-Pressure-Principle Backflow Preventers shall meet ASSE 1013 with either bronze or stainless steel body (equal to that specified on the drawings), rated for continuous pressure applications, with ball or OS&Y valves on the inlet and outlet, and provided with an air gap fitting per ASME A112.1.2:
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- C. Double-Check Backflow-Prevention Assemblies shall meet ASSE 1015 with either bronze or stainless steel body (equal to that specified on the drawings), rated for continuous pressure applications, with ball or OS&Y valves on the inlet and outlet:

1. Manufacturers: Apollo Valve, FEBCO; Watts Industries, Wilkins.
- D. Beverage-Dispensing-Equipment Backflow Preventers shall meet ASSE 1022, stainless steel body, and rated for continuous pressure applications:
1. Manufacturers: Apollo Valve, Watts Industries, Wilkins.
- E. Dual-Check-Valve Backflow Preventers shall meet ASSE 1024 with bronze body, union inlet, and rated for continuous pressure applications:
1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- F. Carbonated-Beverage-Dispenser Dual-Check-Valve Backflow Preventer shall meet ASSE 1032 with stainless steel body, and rated for continuous pressure applications:
1. Manufacturers: Watts Industries, Wilkins.
- G. Hose-Connection Backflow Preventers shall meet ASSE 1052 and shall have a bronze body, capacity of at least 3-gpm (0.19-L/s) flow with up to 10-foot head of water (30-kPa) back pressure, and contain garden hose thread complying to ASME B1.20.7:
1. Manufacturers: Apollo Valve, Watts Industries, Woodford.
- H. Backflow-preventer test kits shall be factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions:
1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.
- 2.3 BALANCING VALVES
- A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. Watts Industries, Inc.; Water Products Div.
 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 3. Body: bronze.
 4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:
1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. Watts Industries, Inc.; Water Products Div.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).

C. Memory-Stop Balancing Valves:

1. Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated bronze.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

D. Automatic Flow Control Valves

1. Basis of Design Manufacturer:
 - a. Griswold Controls
2. Automatic flow control valve cartridges shall automatically control flow rates with $\pm 5\%$ accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 PSID to actuate the mechanism.
3. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
4. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. (Consult the factory for details).
5. All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.
6. Valve shall consist of forged brass bodies and stainless steel cartridge assembly. The valve shall be meet CA1953 for low lead brass if required by the AHJ. The valve shall be rated for 400 PSI/250°F. Valves shall be provided with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent.
7. The body design shall allow inspection or removal of cartridge without disturbing piping connections.
8. The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

- E. Accessories: Provide owner with one meter kit consisting of meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a division of Watts Water Technologies, Inc.
 - d. Symmons Industries, Inc.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting shall be listed on the drawings.
9. Refer to the drawings for additional information.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers:
 - a. Leonard Valve Company.
 - b. Symmons Industries Co.
 - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) 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. Chrome plating shall be utilized in all exposed areas, including below sinks.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 60 mesh.
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 12 mesh.
 - c. Strainers NPS 5 (DN 125) and Larger: 8 mesh.

6. Drain: Pipe plug.

2.6 OUTLET BOXES

- A. Clothes Washer Outlet Boxes shall be furnished with brass quarter turn handled valves and factory installed water hammer arrestors.
 1. Manufacturers: Acorn Engineering, Guy Gray, IPS Corporation, Sioux Chief.
 2. Mounting: Recessed.
 3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
 4. Faucet: Separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 5. Supply Shutoff Fittings: NPS 1/2 (DN 15) quarter turn ball valves.
 6. Drain: NPS 2 (DN 50) standpipe and P-trap for direct waste connection to drainage piping.
 7. Supplies shall be provided with factory installed water hammer arrestors.
- B. Icemaker Outlet Boxes shall be furnished with brass quarter turn handled valve and factory installed water hammer arrestor.
 1. Manufacturers: Acorn Engineering, Guy Gray, IPS Corporation, Sioux Chief.
 2. Mounting: Recessed.
 3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
 5. Supply Shutoff Fitting: NPS 1/2 (DN 15) quarter turn ball valve.
 6. Supply shall be provided with factory installed water hammer arrestor.

2.7 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves shall meet MSS SP-110 for standard-port, two-piece ball valves and have a pressure rating of 400-psig (2760-kPa) minimum CWP.
- B. Gate-Valve-Type, Hose-End Drain Valves shall meet MSS SP-80 for gate valves and shall have a pressure rating of Class 125.
- C. Stop-and-Waste Drain Valves shall meet MSS SP-110 for ball valves or MSS SP-80 for gate valves and have a pressure rating of 200-psig (1380-kPa) minimum CWP or Class 125.

2.8 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 1. Manufacturers: PPP Inc, Sioux Chief.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Copper tube with piston.
 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
 5. Manufacturer's Warranty: Life of the system. Warranty shall be equal to that of Sioux Chief.
- B. Air chambers shall not be used in lieu of water hammer arrestors.

2.9 AIR VENTS

- A. Bolted-Construction Automatic Air Vents shall have a bronze body, 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C), replaceable and corrosion-resistant metal float, stainless steel mechanism and seat, and NPS 1/2 (DN 15) minimum threaded inlet.
- B. Welded-Construction Automatic Air Vents shall have a stainless steel body, 150-psig (1035-kPa) minimum pressure rating, replaceable and corrosion-resistant metal float, stainless steel mechanism and seat, and NPS 3/8 (DN 10) minimum threaded inlet.

2.10 VACUUM RELIEF VALVES

- A. Vacuum relief valves shall meet ANSI Z21.22 and CSA certified. It shall be suitable for low pressure steam and water service with a maximum working pressure of 200 psi (14 bar) and a maximum steam pressure of 15 psi (103 kPa) . The valve shall have a brass body construction, with a protective cap.

- 1. Manufacturers: Apollo Valve, Bell & Gossett, Watts Industries, Wilkins.

2.11 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:

- 1. Manufacturers: PPP Inc, Sioux Chief, Jay R Smith, Watts, Zurn.
- 2. Standard: ASSE 1018.
- 3. Pressure Rating: 125 psig (860 kPa) minimum.
- 4. Body: Bronze.
- 5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
- 6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
- 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers:

- 1. Metraflex, Inc.
- 2. Mason Industries
- 3. Twin City Hose

- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

- 1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).
- 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
- 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

- 1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).

2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Backflow preventers shall be installed in accessible locations for testing purposes.
 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 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.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, and pump.
- E. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) blocking wall reinforcement between studs.
- F. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each circulator pump. Set calibrated balancing valves partly open to restrict but not stop flow.
- G. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 1. Install shutoff valve on outlet if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) blocking wall reinforcement between studs.
- H. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
- I. Install water hammer arresters at every fixture or battery of fixtures which have quick-closing valves (i.e. lavatories, sinks, flush valves, dishwashers, ice machines, washing machines, solenoid valves.) Install per PDI-WH 201. Access panels are not required at arrestors.
- J. Install air vents at high points of water piping.

- K. Vacuum relief valves shall be installed on domestic hot water supply tanks, water heaters, pressure vessels as well as at the high point in the system.
- 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 trap-seal primer manifolds with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Manifold shall be installed a minimum of 1 foot AFF for every 20 feet of horizontal primer piping.
- N. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.2 FLEXIBLE CONNECTOR INSTALLATION

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

3.3 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 thermostatic mixing valves.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each vacuum breaker and 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.

END OF SECTION 221119

SECTION 221123 - 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 for domestic cold- and hot-water circulation:
 - 1. Hot water recirculation pumps.
 - 2. Hot water recirculation controls.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification: Manufacturer's certification of seismic qualification according to ASCE 7-05. Submit ASCE 7-05 special seismic certification as required. Include method used to determine compliance with requirements.
 - 1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- C. ASME Compliance: Comply with ASME B31.9 for piping.

PART 2 - PRODUCTS

2.1 HOT WATER RECIRCULATION PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Industries.
3. Grundfos Pumps Corp.
4. Taco, Inc.
5. Thrush Pump Company Inc.

B. Refer to drawings for pump capacities and characteristics.

C. In-Line Seal-less centrifugal pumps

1. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.
2. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
3. Casing: Bronze, with threaded or companion-flange connections.
4. Impeller: Plastic.
5. Motor: Single speed, unless otherwise indicated.

D. Horizontally Mounted, In-Line, Separately Coupled Centrifugal Pumps

1. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.
2. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
3. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
5. Coupling: Flexible.
6. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
7. Bearings: Oil-lubricated; bronze-journal or ball type.
8. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
9. Motor: Single speed, with grease-lubricated ball bearings; mounted to pump casing.

E. Horizontally Mounted, In-Line, Close Coupled Centrifugal Pumps

1. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
2. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
3. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
4. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.

5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Bearings: Oil-lubricated; bronze-journal or ball type.
7. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
8. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

F. Vertically Mounted, In-Line, Close-Coupled Centrifugal Pumps

1. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.
2. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections. If mounted on concrete base, include pump manufacturer's base attachment for pump mounting to base.
3. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
4. Shaft and Shaft Sleeve: Stainless-steel shaft, with copper-alloy shaft sleeve.
5. 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.
6. Bearings: Oil-lubricated; bronze-journal or ball type.
7. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.
8. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.

2.2 HOT WATER RECIRCULATION CONTROLS

A. Aquastats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Square D.
 - c. White-Rodgers Div.; Emerson Electric Co.
2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
3. Operation of Pump: On or off.

B. Timers: Electric time clock for control of hot-water circulation pump.

1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Johnson Controls, Inc.
2. Type: Programmable, seven-day clock with manual override on-off switch.
3. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
4. Operation of Pump: On or off.

C. Time Delay Relay: Electric, for control of the hot-water circulation pump between the water heater and connected hot-water storage tank.

1. Manufacturers:

- a. Honeywell International, Inc.
 - b. Johnson Controls, Inc.
 - c. Square D.
 - d. White-Rodgers Div.; Emerson Electric Co.
2. Type: Adjustable time-delay relay.
 3. Range: Up to five minutes.
 4. Operation of Pump: On or off.
 5. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with ANSI HI 1.4.
- B. Comply with mounting and anchoring requirements for seismic installations.
- C. Install in-line, horizontally mounted and seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- F. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- G. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.2 CONNECTIONS

- A. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping Specialties."

2. Install shutoff valve and strainer on suction side of pumps, and check valve, shutoff, and throttling valve on discharge side of pumps. Install valves same size as connected piping.
 3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect aquastats, time-delay relays, and/or timers to pumps that they control. Adjust initial temperature set points. Circulation pumps shall be controlled by aquastats installed in the recirculation piping unless otherwise indicated on the drawings.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for the booster pump(s).
- B. Contractor shall perform tests and inspections for recirculation pumps.
- C. Tests and Inspections:
1. Perform visual and mechanical inspection.
 2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:

- 1. Pipe, tube, and fittings.
- 2. Special pipe fittings.

- B. Related Sections include the following:

- 1. Division 22 Section "Sump Pumps and Lift Stations."
- 2. Division 22 Section "General Duty Valves for Plumbing"
- 3. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment"
- 4. Division 22 Section "Sanitary Waste Piping Specialties"

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

- 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
- 2. Sanitary Sewer Force-Main Piping: 100 psig (690 kPa).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and fittings shall conform to ASTM A 74 and CISPI 301 and shall be service class. Joints for hub and spigot shall be installed with rubber compression gaskets conforming to the requirements of ASTM C 564 or shall be installed with lead and oakum or hemp fiber per ASTM B29. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.
- B. Manufacturer's:
 - 1. Charlotte Pipe and Foundry
 - 2. Tyler Pipe
 - 3. AB&I Foundry

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and fittings shall conform to ASTM A 888 and CISPI 301. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.
 - 1. Manufacturer's:
 - a. Charlotte Pipe and Foundry
 - b. Tyler Pipe
 - c. AB&I Foundry
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings. The cast iron system shall be equal to that as manufactured and distributed by Conine Manufacturing Co. Inc. The installation shall be in accordance with approved plans and specifications, and in compliance with Cast Iron Sovent Design Manual No. 802. The contractor shall provide a Sovent manufacturer's representative on site prior to the installation of any fittings. The representative shall fully instruct the contractor on proper installation of the Sovent, and the throughout the project as required. The contractor shall provide to the architect/engineer a letter from the Sovent representative stating such.
- C. Shielded Couplings: 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, marked with NSF, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers: Anaco-Husky, Fernco, Tyler Pipe, MIFAB, Mission.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: ASTM C1540, with stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers: Anaco-Husky, Fernco, Tyler Pipe, MIFAB, Mission.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Pipe with Recycled Content: manufactured from PVC compound with a minimum cell class of 11432 for inside and outside layers and 11211 for center layer per ASTM D4396. Center layer of pipe shall be comprised of 100% recycled material and make up 30-80% of the overall wall thickness. Pipe shall be Schedule 40 iron pipe size conforming to ASTM F 1760.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- B. 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."
- C. 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.
- D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- E. Install PVC soil and waste drainage and vent piping according to ASTM D 2665 and underground PVC soil and waste drainage piping according to ASTM D 2321.
- F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- G. 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.
- H. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- I. Install a complete sanitary drainage system. All soil, waste, and vent piping; connection to all plumbing fixtures, special equipment, floor drains and other equipment requiring such connections.
- J. Verify all invert elevations and measurements prior to the installation of materials in the building.
- K. Above slab sanitary and vent piping shall be supported from the building structure. Under no circumstances shall piping be supported from equipment, piping or conduits within the building structure.
- L. All floor drains shall be set true and level and shall be protected properly throughout entire construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Safe with lead as specified. Resealing prime connections are required on all floor drains except floor drains located in showers.
- M. Trap each fixture and piece of equipment requiring drainage connections. Trap seals shall be 4" deep seal type. Traps shall be set true and level and located within the limits of the code requirements. Traps shall not be used as a separator, interceptor or other type of device to retain solids. All traps shall be provided with screw type approved cleanout plugs when specified. Traps shall be protected during construction and sealed off to prevent stones, debris and other foreign matter from entering before use. When running traps are used, they shall be located for full accessibility with double cleanout.
- N. Provide plugs or caps for all opening during the construction phase. The temporary plug shall be plastic cap or equivalent. Duct tape is unacceptable for use as a plug, support or to separate ferrous from non-ferrous materials for the construction phase.
- O. All vents through roof shall be installed a minimum of 10'-0" from all fresh air intake to air handling equipment and offset minimum of 3'-0" from edge of roof lines, parapets and all other flashing. Vent piping shall be collected so roof will be pierced a minimum number of times. Plumbing vents through roof shall be a minimum of 2 inches. Vents through roof shall be painted with two coats of epoxy matching roof color.
- P. Clean-out plugs in piping shall be set with Teflon sealer or similar engineer approved equal.
- Q. Contractor shall coordinate with General Contractor to ensure floor drains are level with finished floor and finished floor is sloped in all directions toward floor drain.
- R. Plastic piping shall not be used in plenum spaces unless UL listed for this application and approval is given by the AHJ.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping 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 hubless-coupling joints.
 - 3. Solid-wall PVC-DWV pipe, PVC-DWV socket fittings, and solvent-cemented joints.
 - 4. PVC with recycled content pipe, PVC-DWV socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, vent piping shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC-DWV pipe, PVC-DWV socket fittings, and solvent-cemented joints.
 - 4. PVC with recycled content pipe, PVC-DWV socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Aboveground sanitary-sewage force mains shall be any of the following:
 - 1. Galvanized steel pipe, pressure fittings, and threaded joints.
 - 2. Grooved-end galvanized steel pipe, grooved-joint system fittings and couplings, and grooved joints.
 - 3. Solid wall PVC pressure pipe and fittings with solvent weld joints.
- E. Indirect Waste piping NPS 1 1/4 and smaller shall be any of the following:
 - 1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Indirect Waste piping NPS 1 1/2 and larger shall be any of the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 3. Solid-wall PVC pipe, PVC-DWV socket fittings, and solvent-cemented joints.
 - 4. PVC with recycled content pipe, PVC-DWV socket fittings, and solvent-cemented joints.

3.3 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.4 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. Duct tape is not an acceptable cap.

3.5 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cast-Iron Floor Cleanouts (FCO):
 - 1. Manufacturers: Josam, Jay R Smith, Watts, Zurn.
 - 2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 - 3. Size: Same as connected branch.
 - 4. Body Material: Cast iron.
 - 5. Closure: Gas and watertight bronze plug with tapered threads with round scoriated secured top.
 - 6. Adjustable Housing Material: Cast iron with threads.
 - 7. Frame and Cover Material and Finish: Nickel-bronze.
 - 8. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
 - 9. Cleanout shall be equal to Zurn ZN1400-NL-BP.
- B. Cast-Iron Wall Cleanouts (WCO):
 - 1. Manufacturers: Josam, Jay R Smith, Watts, Zurn.
 - 2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.
4. Body: cast-iron as required to match connected piping.
5. Closure: drilled-and-threaded bronze plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, stainless-steel cover plate with screw.
8. Cleanout shall be equal to Zurn Z1441-BP.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains (Refer to Floor Drain Schedule on drawings for identification):

1. Manufacturers: Josam, Jay R Smith, MIFAB, Watts, Zurn.
2. Standard: ASME A112.6.3.
3. If an approved manufacturer other than that specified is submitted, all options specified on the drawings shall be provided on the submitted floor drain.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains (hub drain):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. 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 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 100 feet (30 meters).
 4. Locate at base of each vertical soil and waste stack.
- B. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- C. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- D. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
- E. Install traps on drain outlets. Omit traps on indirect wastes unless trap is indicated.
- F. 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.
- G. Install sleeve waterproofing device on all piping sleeves through floors that do not require a fire rating.

3.2 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. Duct tape is not an acceptable plug or cap.

3.3 DEMONSTRATION

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

END OF SECTION 221319

SECTION 223300 - 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. Residential & light-commercial, storage electric water heaters.
 - 2. Expansion tanks.
 - 3. Water heater accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties, and accessories.
- B. Warranty: Special warranty specified in this Section.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification: Manufacturer's certification of seismic qualification according to ASCE 7-05. Submit ASCE 7-05 special seismic certification as required. Include method used to determine compliance with requirements.
 - 1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- 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. ASME Compliance: Where ASME-code construction is indicated, fabricate and label domestic-water heater storage tanks to comply with ASME.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.7 COORDINATION

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

1.8 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:
 - 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. Residential Electric Water Heaters:
 - 1) Storage Tank: Six years.
 - 2) Controls and Other Components: One year parts and labor.
 - b. Expansion Tanks: One year.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All tanks, shall be furnished with the following:
 - 1. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 2. Jacket: Steel with enameled finish.
 - 3. Anode Rods: Factory installed, replaceable magnesium.

4. Dip Tube: Provide unless cold-water inlet is near bottom of tank. Not required on commercial booster heaters.
 5. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
 6. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 7. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
- B. Tappings and connections shall be factory fabricated of materials compatible with tank. Attach tappings to tank before testing. Tappings and connections on each tank shall be:
1. Residential: ASME B1.20.1 pipe thread.
 2. Commercial NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 3. Commercial NPS 2-1/2 (DN 65) 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.
- C. Refer to Water Heater Schedule on the drawings for additional information on the capacity and characteristics of each heater.

2.2 ELECTRIC STORAGE TANK TYPE WATER HEATERS

- A. Residential & Light Commercial Storage Electric Water Heaters: Comply with UL 174 for residential storage electric water heaters.
1. Manufacturers:
 - a. Lochinvar Corporation.
 - b. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - c. A.O. Smith, Water Products Company.
 - d. Bradford White Corporation.
 - e. Everlast
 2. Storage-Tank Construction: Steel with a pressure rating of: 150 psig (1035 kPa).
 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - b. Heating Elements: electric, screw-in immersion type with 12 kW or less total, and wired for non-simultaneous operation, unless otherwise indicated.
 - c. Temperature Control: Adjustable thermostat for each element.
 - d. Safety Control: High-temperature-limit cutoff device or system.

2.3 EXPANSION TANKS

- A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
1. Manufacturers:
 - a. AMTROL Inc.

- b. Watts Regulator Co.
- c. Wessels Company

2. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- b. Air-Charging Valve: Factory installed.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

2.4 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
- C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN 25) drain outlet with ASME B1.20.1 pipe thread.
- D. Water Heater Stands: Factory-fabricated galvanized steel stand for floor mounting and capable of supporting water heater. Shall be provided with means of anchoring to floor. Heater shall be installed a minimum of 14" (350mm) above floor. Manufacturer basis of design is Hubbard Holdrite.
- E. Drain Pans: Corrosion-resistant metal or high density polyethylene plastic with raised edge. The dimensions shall not be less than 2" (50mm) larger than the base of the water heater and shall include a drain outlet not less than NPS 3/4 (DN 20).
- F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- G. Pressure Reducing Valve: ASSE 1003, water-pressure reducing valve. Set at 25-psig- (172.5-kPa-) maximum outlet pressure, unless otherwise indicated to be installed on commercial booster heaters at dishwashers.
- H. Water Hammer arrestors: ASSE 1010 or PDI WH 201, Size A water hammer arrester installed on booster heaters.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4. Vacuum relief valves shall be installed on all systems in which the elevation of the water heater is above that of the plumbing fixtures and equipment that it serves.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction.

- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Comply with mounting and anchoring requirements for seismic installations.
- B. Install residential water heaters on the floor with a drain pan unless a concrete base, stand or suspended platform is indicated.
- C. Install water heaters level and plumb, according to construction documents, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks.
- E. Include a shutoff valve and thermometer in each water heater's inlet and outlet piping.
- F. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- G. Fill water heaters with water.
- H. Charge expansion tanks with air.
- I. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.2 IDENTIFICATION

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

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

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

END OF SECTION 223300

SECTION 224000 - 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 SUMMARY

- A. This Section includes all conventional plumbing fixtures and related components.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 22 Section "Emergency Plumbing Fixtures."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all fixtures to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. 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. Flush 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. Toilet Seats: Equal to 5 percent of amount of each type installed.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. However, if fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in ANSI A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
- 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 Mop-Service Basins: ANSI Z124.6.
 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 6. Vitreous-China Fixtures: ASME A112.19.2M.
 7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 2. Faucets: ASME A112.18.1.
 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 6. Pipe Threads: ASME B1.20.1.
 7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 8. Supply Fittings: ASME A112.18.1.
 9. Brass Waste Fittings: ASME A112.18.2.
- I. 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. Manual-Operation Flushometers: ASSE 1037.
 4. Brass Waste Fittings: ASME A112.18.2.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Flexible Water Connectors: ASME A112.18.6.
 3. Floor Drains: ASME A112.6.3.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Hot-Water Dispensers: ASSE 1023 and UL 499.
 6. Off-Floor Fixture Supports: ASME A112.6.1M.
 7. Pipe Threads: ASME B1.20.1.
 8. Plastic Toilet Seats: ANSI Z124.5.
 9. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. All fixtures basis of design is listed on the drawings. The following manufacturers are approved subject to compliance with the requirements listed on the drawings.
1. Lavatory faucets: American Standard, Chicago Faucets, Kohler, Moen, Symmons, Zurn.
 2. Sink faucets: American Standard, Chicago Faucets, Delta, Elkay, Grohe, Kohler, Moen, Sloan, Zurn.
 3. Flush valves: Kohler, Sloan, Zurn, Hydrotek.
 4. Toilet seats: American Standard, Bemis, Centoco, Church, Kohler, Olsonite.
 5. Protective shielding guards: McGuire, Plumberex, TRUEBRO, Zurn.
 6. Fixture supports: Josam, MIFAB, Jay R Smith, Watts, Zurn.
 7. Water closets: American Standard, Kohler, TOTO USA.
 8. Lavatories: American Standard, Kohler, TOTO USA.
 9. Commercial sinks: Elkay, Just.
 10. Kitchen sinks: Kohler, American Standard, Elkay, Just.
 11. Bar sinks: Kohler, American Standard, Elkay, Just.
 12. Service basins: Acorn, Fiat, Stern-Williams.
 13. Disposers: In-Sink-Erator; KitchenAid.
 14. Drinking fountains & water coolers: Filtrine, Halsey Taylor, Haws, Oasis, Sunroc, Elkay.
 15. Clinical sinks: American Standard, Kohler, Zurn.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. 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.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- E. Install all fixtures level and plumb according to roughing-in drawings.
- F. 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.
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install flush valves for accessible water closets with handle mounted on wide side of compartment.
- J. Install faucet-spout and flow-control fittings with specified flow rates and patterns.
- K. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- L. 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."
- M. Unless otherwise noted in Division 07, seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- N. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.2 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.

3.3 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flush valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Adjust drinking fountains for proper temperature setting and the flow regulators for proper flow and stream height.
- E. Install fresh batteries in sensor-operated mechanisms.
- F. Adjust sensor angle and range on sensor-operated faucets and flush valves for proper operation.

3.4 CLEANING

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

3.5 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 224000

SECTION 224500 - EMERGENCY 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 SUMMARY

- A. This Section includes the following emergency plumbing fixtures:
 - 1. Eyewash equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

1.7 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- B. Regulatory Requirements: Comply with requirements in ANSI A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. All fixtures basis of design is listed on the drawings. The following manufacturers are subject to compliance with the requirements listed on the drawings.
 - 1. Eyewash equipment: Bradley, Encon, Guardian, Haws, Speakman.
 - 2. Water tempering equipment: Armstrong International, Bradley, Leonard, Powers, Symmons

2.2 EYEWASH EQUIPMENT

- A. Sink, Swivel-Type, Plumbed Eyewash Unit:
 - 1. Capacity: Not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.
 - 2. Supply Piping: NPS 1/2 (DN 15) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - 3. Control-Valve Actuator: Movement of spray-head assembly to position over sink.
 - 4. Spray-Head Assembly: Two spray heads with offset piping.
 - 5. Mounting: Deck next to sink.

2.3 WATER-TEMPERING EQUIPMENT

- A. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
 - 1. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C) tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Adjust thermostatic mixing valve temperature settings.
- H. Install trap and waste to wall on drain outlet of fixture receptors that are to be directly connected to sanitary drainage system.
- I. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.
- J. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
- K. Adjust or replace fixture flow regulators for proper flow.
- L. Fill self-contained fixtures with flushing fluid.

END OF SECTION 224500