



Delivering water and power™

Construction Specification Manual

Salt River Project

Technical Specification Index – April 2024

Division 22

Division	Title	Updated
DIVISION 22: PLUMBING		
220513	Common Motor Requirements for Plumbing Equipment	Revised 04/22
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220519	Meters and Gages for Plumbing Piping	Revised 06/23
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224716	Water Coolers	Revised 06/23

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation
2. Direct drive, long-life, brushless DC electronically commutated motors (ECM) with external rotor and integrated electronic circuitry.

1.2 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. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.3 ACTION SUBMITTALS

A. Provide product data for each motor including, but not limited to, horsepower rating, voltage rating, amperage rating, ambient temperature rating, phasing, operating frequency, service factor, insulation class, frame size, motor efficiency, bearing type, etc.

1.4 CLOSEOUT SUBMITTALS

A. Operation Data: Include instructions for safe operating procedures.

B. Maintenance Data: Include manufacturers model number, manufacturer's installation instructions, assembly drawings, bearing data including replacement sizes, lubrication instructions, adjustment procedures, inspection period, recommended cleaning methods and materials, testing methods, shaft grounding brush replacement procedures and calibration tolerances.

- C. Statement of Guarantee including date of termination.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified with plumbing equipment schedules or Sections
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.
- D. Motors larger than 5HP shall be 277V or 480V, 3 Phase if available at site.
- E. Provide all TEFC motors with anti-friction grease lubricated ball bearings, with a bearing AFBMA B-10 life of 100,000 hours and sealed from the environment. Provide factory lubrication of all motors prior to shipment. Provide all grease-lubricated bearings with relief fittings.
- F. Provide all ODP motors with sealed anti-friction grease lubricated ball bearings, with a bearing AFBMA B-10 life of 100,000 hours. Provide factory lubrication of all motors prior to shipment. Provide all grease-lubricated bearings with relief fittings.
- G. Provide nameplates of stainless steel or other approved corrosion resistant material to provide a permanent legible marking, containing NEMA data plus guaranteed minimum efficiency. Attach nameplates and connection plates to the motor frame by rivets or screws.
- H. Provide motors with conduit boxes that are fully rotatable, diagonally split, including gasket between cover and box, and box and frame, with threaded hubs and a grounding lug located within the box for ground conductor connection.

2.2 MOTOR CHARACTERISTICS

- A. Indoor Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Outdoor duty: Continuous duty at ambient temperature of 50 degrees C and at altitude of 3300 feet above sea level.
- C. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

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- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Permanently greased or sealed, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Insulation: Class F unless otherwise indicated
- G. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 4. Measure shaft to ground voltage. If voltage exceeds 2v, install a shaft ground ring similar to "AEGIS SGR" on DE (driven end)

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 DIRECT DRIVE ELECTRONICALLY COMMUTATED MOTORS

- A. High performance direct drive, long-life, low-temperature brushless DC electronically commutated motor (EC-Motor) with external rotor and integrated maintenance-free electronic circuitry and electronics.
- B. The motor shall be manufactured with maintenance-free, permanently lubricated ball bearings and shall be statically and dynamically balanced in accordance with ISO 1940 part 1.
- C. The motor shall be closed, protection level IP 54, thermal class 155 with permissible operating temperature of -13°F to 140°F.
- D. Motor efficiency class shall comply with IE4. Fan characteristic curves indicate measurements on a chamber test in accordance with ISO5801.
- E. External rotor motors shall meet the requirements for circulating electric machines set forth in DIN EN 60 034-1 (VDE 0530 Part 1).
- F. Motors shall be listed per UL 1995.
- G. Provided motor controller configurable for motor speed control via BACnet interface (MSTP), Modbus, 0-10 VDC input or 4-20 mA input.
- H. 65KAIC SCCR disconnect shall be provided.

2.7 MANUFACTURERS

- A. Subject to compliance with the requirements included in this Section for motors not included as part of a listed assembly provide products by one of the following:
 - 1. General Electric
 - 2. Emerson
 - 3. A.O. Smith
 - 4. U.S. Motors
 - 5. WEG
 - 6. Baldor
 - 7. Bell and Gossett

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Termination – 5HP and above
 - 1. In motor terminal box, mechanically terminate motor leads and conductors with crimped or compression “eyes”. Bolt eyes together with grade 5 bolt, lock washer and nut.
 - 2. Tape: First layer of tape is 3M Scotch 27 tape, overlay that with self-sealing rubber wrap splicing 3M Scotch 23 tape. Finish with wrap of #33+ Scotch electrical tape (or equivalent)
 - 3. Terminal blocks: Mechanical connection terminal blocks for size, listing and rating of motor conductors. Ample space required for insulated bushing and tape in terminal box.
- B. Manufacturers:
 - 1. Cooper Bussman
 - 2. Burndy
- C. Install in accordance with manufacturer's instructions.
- D. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

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COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Plumbing demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Supports and anchorages.
 - 11. Refrigerant management records.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE, COORDINATION, AND SAFETY

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations. Piping, equipment, and associated accessories kept on-site should be stored off the ground on skids, ends should be capped or sealed, and these items should be covered with plastic to prevent fouling or contact with excessive moisture. Piping and equipment should be cleaned of debris inside and out before installation and should be kept clean and protected throughout construction.
- E. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section 08 31 13 "Access Doors and Frames."
- F. All shutdowns are to be requested with the respective Owner's Project Manager. All shutdowns must have a shutdown request filled out for the applicable trade and submitted to the respective trade's shop calendar 48 hours in advance, they shall include Methods of Procedure. Emergency situations will be addresses and a case-by-case basis.
- G. Hot Work Permits
 - 1. All "Hot Work" must be preauthorized and signed by the Owner's Project Manager via a signed "SRP Hot Work Permit."
 - 2. Burn permits are good for one full working day when burn activity occurs at project specific locations.
 - 3. If a temporary working area (fab area) is established and approved by Owner's Risk Management and Project Manager, an approved hot work permit may be approved for a longer period.
 - 4. SRP Burn Permits require 1-hour fire watch after any open flame or welding operation, or other operation generating sparks or heat.
- H. The plumbing materials and installation shall conform to the applicable codes and standards referenced on the construction documents.
- I. Technicians working on the refrigerant circuits of equipment and appliances are required to possess Section 608 Technician Certification for the work they will be performing and be a Journeyman or supervised onsite by a Journeyman.

COMMON WORK RESULTS FOR PLUMBING

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1.4 ACTION SUBMITTALS

- A. Product Data in numeric and diagrammatic format as appropriate.
- B. Refrigerant Management Records
 - 1. If a technician performs any work on the refrigerant circuit of equipment or an appliance, the technician will complete and submit a **Refrigerant Service Input Form** to the SRP O&M Representative with 2 calendar days after completion of the work.
 - 2. If a technician removes equipment or an appliance containing refrigerant and surrenders it to SRP, the technician will complete and submit a **FACILITIES SERVICES DISPOSAL SUBMISSION FORM** to the SRP O&M Representative within 2 calendar days after completion of the work.
 - 3. If a technician installs new equipment or appliances containing refrigerant, the technician will attach a picture of the nameplate listing the refrigerant charge requirements to the submitted **Refrigerant Service Input Form**.
 - 4. All systems charged in the field at a value different than stated on the equipment name plate must be documented on a Refrigerant Service Input form and on a new engraved label permanently attached to the equipment near the point of charging.

1.5 CLOSEOUT SUBMITTALS

- A. Operation Data: Include instructions for safe operating procedures.
- B. Maintenance Data: Include manufacturers model number, manufacturer's installation instructions, assembly drawings, maintenance procedures, adjustment procedures, inspection period, recommended cleaning methods and materials.
- C. Statement of Guarantee including date of termination.

PART 2 - PRODUCTS

2.1 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.2 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 degrees F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly with dielectric bolt insulators or fully floating, powder-coated, plate-steel, companion flange with EPDM insulator to prevent contact with copper flange adapter, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanize-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.

2.3 MECHANICAL SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
 - 6. GPT Industries
 - 7. Garlock LinkSeal
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- C. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

- D. Pressure Plates: Carbon steel above grade and stainless steel below grade. Include two for each sealing element.
- E. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating above grade and stainless steel below grade of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Galvanized-Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Underdeck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece or two-piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece or two-piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

2.6 GROUT

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

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 02 Existing Conditions for general selective demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Label "Abandoned in Place." Items can only be abandoned in place with prior written approval from the Owner.
 - 3. Equipment to Be Removed: Disconnect and cap services, remove and discard equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational. Operational test to be witnessed by Owner.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - 6. Perform cutting, fitting, and patching of plumbing and building materials required to install new equipment and building materials in existing structures.
 - 7. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - 8. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- C. 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 PIPING SYSTEMS COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by Engineer.
- C. Install piping in concealed locations, 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 to conserve building space and not interfere with use of space.
- F. Group piping wherever practical at common elevations and locations.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

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- H. Install piping to permit servicing of valves and specialties.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance
- J. Install piping at indicated slopes.
- K. Install piping free of sags and bends.
- L. Install factory fabricated fittings for changes in direction and branch connections.
- M. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- N. Install piping to allow application of insulation.
- O. Select system components with pressure rating equal to or greater than system operating pressure.
- P. Install escutcheons for exposed penetrations of piping through walls, ceilings, and floors.
- Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, manholes, catch basins and concrete floor and roof slabs. Extend floor sleeves 2 inches above top of floors above grade.
- R. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Underground, Exterior-Wall, manhole, and catch basin Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials as indicated on Drawings, or as required by authorities having jurisdiction.
- U. Verify final equipment locations for roughing-in.

- V. Install pressure gage(s) on suction and discharge piping at each plumbing pump and packaged booster pump in accordance with the standard details. Comply with requirements in Division 22 Section 22 05 19 "Meters and Gages for Plumbing Piping" for pressure gages
- W. Install thermometer(s) on inlet and outlet piping at each storage tank style water heater in accordance with the standard details. Comply with requirements in Division 22 Section 22 05 19 "Meters and Gages for Plumbing Piping" for thermometers.
- X. Refer to equipment specifications in other Sections of these Specifications and approved submittals for roughing-in requirements.
- Y. Install piping with the least quantity of joints practical, unless necessary for expansion and contraction.
- Z. Coordinate the plumbing installation with the framing to avoid notching, drilling, and cutting of steel studs. Utilizing the pre-punched openings in steel studs is the only approved method of installing piping through steel studs.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Non-pressure Piping: Join according to ASTM D 2855.
 - 4. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Pipe Systems:
 - a. NPS 2 and smaller: Install dielectric coupling or nipple fitting to connect piping materials of dissimilar metals.
 - b. MPS 2-1/2 and larger: Install dielectric flange to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components in accordance with the manufacturer's written instructions and without removal of any permanent construction as stated in the plumbing code. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 for slotted channel framing and miscellaneous steel framing.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to structure as required to support applied loads.

3.9 GROUTING

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

- G. Place grout around anchors.
- H. Cure placed grout.

3.10 FIELD QUALITY CONTROL

A. Preparing for Testing:

1. Leave joints including welds un-insulated and exposed for examination during the test.
2. Provide temporary restraints for expansion joints which cannot sustain the reaction due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
3. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
4. Install relief valves set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during test.

B. Testing: Test hydronic piping as follows:

1. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of that liquid.
2. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
3. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for a vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90% of specified minimum yield strength, or 1.7 times the "SE" value in "Appendix A of B31.9, Code for Pressure Piping, Building Services Piping".
4. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
5. Prepare and submit test reports.

END OF SECTION

SECTION 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermometers
 - 2. Thermowells
 - 3. Pressure Gages
 - 4. Meters

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL CASE LIQUID IN GLASS THERMOMETERS

- A. Manufactures: Subject to compliance with requirements, provide products by one of the following:
 - 1. Miljoco Corporation
 - 2. Trerice, H. O. Co
 - 3. Weiss Instruments
 - 4. Winters Instruments
 - 5. Palmer - Wahl
- B. Metal-Case, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Die-cast aluminum or brass 9 inches long in mechanical rooms, 7 inches long other locations.
 - 3. Case Form: Back angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in degrees F.
 - 6. Window: Glass
 - 7. Stem: Copper plated steel, aluminum, or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.

8. Connector: adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device, and with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of range, or plus or minus 1 scale division to maximum of 1.5 percent of range.
10. Range: The maximum operating temperature should not exceed 75% of the full-scale range. The normal operating range shall be in the middle half of the range (between 25% and 75% of the full-scale range); whenever possible.

2.2 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer used.
- B. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material: Brass in copper piping systems, Type 316 stainless steel in other piping systems.
 4. Type: Stepped shank, unless straight or tapered shank indicated.
 5. Bore: Diameter required to match thermometer bulb or stem.
 6. Insertion Length: Length required to match thermometer bulb or stem.
 7. Lagging Extension: Include on thermowells for insulated piping and tubing.
 8. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- C. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 2. Ernst Gage Co.
 3. Miljoco Corp
 4. Trerice, H. O. Co.
 5. Palmer- Wahl Instruments Inc.
 6. Weiss Instruments, Inc.
 7. Winters Instruments
- B. Direct Mounted, Metal Case, Dial Type Pressure Gages
 1. Standard: ASME B40.100.
 2. Case: Dry Type, cast aluminum, stainless steel or drawn steel, 4-1/2-inch nominal diameter.
 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Red or other Dark-colored metal.
8. Window: Glass
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
11. Range: The maximum operating pressure should not exceed 75% of the full-scale range. The normal operating range should be in the middle half of the range (between 25% and 75% of the full-scale range); whenever possible.

2.4 WATER METERS

- A. Positive Displacement Water Meters:
 1. Manufacturers: Subject to compliance with requirements, provide a Badger Recordall Disc Industrial M Series Meter with an HR-LCD 4-20 Scaled/Unscaled Register or like product by one of the following:
 - a. ABB Water Meters, Inc.
 - b. Grinnell Corporation; Mueller Co.; Hersey Meters.
 - c. Water Specialties Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Provide thermowells with an approved heat transfer medium such as graphite or heat transfer paste to provide optimal accuracy and response time.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install remote-mounted pressure gages on panel.
- J. Install valve and snubber in piping for each pressure gage for fluids.
- K. Install test plugs in piping tees.
 - 1. Suction and discharge of each domestic water pump.

3.2 CONNECTION

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 GAGE APPLICATIONS

- A. Install Dry-case type pressure gages in the following locations:
 - 1. Discharge of each pressure reducing valve
 - 2. Those other locations indicated in the standard details.

3.5 THERMOMETER SCHEDULE

- A. Install liquid-in-glass or digital thermometers in the following locations:
 - 1. Outlet of each domestic, hot water storage tank
 - 2. Outlet of each domestic water heater
 - 3. Outlet of each hot water circulation pump
 - 4. Outlet of each tempered water recirculation pump.
 - 5. Outlet of each thermostatic mixing valve serving more than one fixture.
 - 6. Those other locations indicated in the standard details.
- B. Thermometer stems shall be of length to match thermowell insertion length.
- C. Provide the following temperature ranges for thermometers:
 - 1. Domestic hot and tempered water: 30 to 180 degrees F, with 2-degree scale divisions

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following general-duty valves:

1. Bronze ball valves.
2. Cast iron ball valves.
3. Bronze check valves.
4. Gray-iron swing check valves.
5. Spring-loaded, lift-disc check valves.
6. Bronze gate valves.
7. Cast-iron gate valves.
8. Ductile iron butterfly valves.

1.2 ACTION SUBMITTALS

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

1. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances.
2. Include list indicating valve and its application.
3. Include rated capacities; furnished specialties; and accessories.

1.3 QUALITY ASSURANCE

A. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for dimension and design criteria.
2. ASME B31.9 Building Services Piping

B. NSF Compliance: NSF 61 & or NSF 372 test standards and Federal Legislation known as "Reduction of lead in drinking water act" for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified to comply with Federal Legislation.

C. Source Limitations for Valves: Obtain each type of valve from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.

GENERAL DUTY VALVES FOR PLUMBING PIPING

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

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Valves: NPS 2 and smaller: Threaded or soldered ends, unless noted otherwise indicated.
- C. Valves: NPS 2-1/2 and Larger: Flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
1. Handwheel: Non-heating style of cast, malleable iron or aluminum for gear-operated, quarter-turn valves and all valves other than quarter-turn types, located not more than 8 feet above walkway.
 2. Chainwheel Actuators: For gear-operated, quarter-turn valves and all valves other than quarter-turn types, located more than 8 feet above walkways. Adjust chain length to maintain 7 feet clearance above walkway.
 3. Lever Handle: For quarter-turn valves NPS 4 and smaller, except plug valves. Provide infinite-position handle with open-position memory stop in balancing applications, and others indicated on Drawings.
 4. Gear Operators: For quarter-turn valves larger than NPS 4, except plug valves.
- G. Valves in Insulated Piping: Provide with 2-inch stem extensions on insulated valves with the following features.
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation
 2. Butterfly Valves: With extended neck.

- H. Solder Joint: With sockets according to ASME B16.18.
 - 1. Caution: Use solder with melting point below 840°F for angle, check, and gate valves; below 421°F for ball valves.
- I. Threaded: With threads according to ASME B1.20.1.
- J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- K. 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. Subject to compliance with requirements, provide product by one of the following:
 - a. Honeywell Braukmann
 - b. Milwaukee Valve Company
 - c. Watts industries.; Water Products Div.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig
 - c. CWP Rating: 600 psig
 - d. Temperature Range: 0 °F to 400 °F
 - e. Body Design: Two piece.
 - f. Body Material: Lead Free silicon bronze copper alloy.
 - g. Ends: Threaded.
 - h. Seats: PTFE
 - i. Stem: Stainless Steel.
 - j. Ball: Stainless Steel.
 - k. Port: Full.

2.3 CAST IRON BALL VALVES

- A. Two-piece, full-port, Class B Cast Iron:
 - 1. Subject to compliance with requirements, provide Watts Series G4000 (NPS 4 and 6) or a comparable product by one of the following:
 - a. Honeywell Braukmann
 - b. Milwaukee Valve Company
 - 2. Description
 - a. Standard: MSS SP-72
 - b. SWP: 125 psi
 - c. CWP; 200 psi
 - d. Body design: Two piece
 - e. Body Material: Cast iron with FDA food grade epoxy coating.
 - f. Ends: Flanged
 - g. Seats: PTFE
 - h. Stem: 304 Stainless Steel

GENERAL DUTY VALVES FOR PLUMBING PIPING

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- i. Ball: 304 Stainless Steel
- j. Port: Full

2.4 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Subject to compliance with requirements, provide product by one of the following:
 - a. Milwaukee Valve Company
 - b. Watts Industries Inc; Water Products Division
 - 2. Description
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: Lead Free silicon bronze copper alloy.
 - e. Ends: Threaded.
 - f. Disc: PTFE

2.5 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Subject to compliance with requirements, provide product by one of the following:
 - a. Grinnell Corporation
 - b. Milwaukee Valve Company.
 - c. Mueller Co.
 - d. Watts Industries, Inc. Water Products Division
 - 2. Description
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Lead Free silicon bronze copper alloy or stainless steel.
 - g. Gasket: Asbestos free.

2.6 BRONZE GATE VALVES

- A. Class 125, RS Bronze Gate Valves:
 - 1. Subject to compliance with requirements, provide product by one of the following:
 - a. Milwaukee Valve Company
 - b. Watts Industries, Inc. Water Products Division.
 - 2. Description
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: Lead Free silicon bronze copper alloy.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Lead Free bronze copper alloy.

GENERAL DUTY VALVES FOR PLUMBING PIPING

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- f. Disc: Solid wedge; Lead Free silicon bronze copper alloy.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron or bronze

2.7 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

- 1. Subject to compliance with requirements, provide product by one of the following:
 - a. Grinnell Corporation
 - b. Milwaukee Valve Company
 - c. Watts Industries, Inc. Water Products Division
- 2. Description
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A536, ductile iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Lead Free Bronze.
 - f. Disc: Solid EPDM coated ductile iron wedge.
 - g. Packing and Gasket: Asbestos free

2.8 SPRING LOADED LIFT DISC CHECK VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company
 - b. Watts Industries, Inc.; Water Products Division.
- 2. Description
 - a. Standard: FCI 74-1
 - b. CWP Rating: 125 psig.
 - c. Body Material: Lead Free Bronze
 - d. Spring: Bronze

2.9 DUCTILE IRON BUTTERFLY VALVES

A. Manufacturers:

- 1. Ductile Iron, Lug Body, Butterfly Valves:
 - a. Milwaukee Valve Company.
 - b. Watts Industries, Inc.; Water Products Div.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. SWP Rating: 150 psig.
 - c. Body Material: ductile iron.
 - d. Liner: EPDM.
 - e. Disc: Aluminum/bronze.
 - f. Stem: Stainless Steel.

GENERAL DUTY VALVES FOR PLUMBING PIPING

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PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If not indicated, use the following:
 - 1. Shutoff Service: Ball, Butterfly
 - 2. Throttling Service: Ball valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings are acceptable.
- C. Domestic and Industrial Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, lead free bronze.
 - 2. Ball Valves NPS 2-1/2: Class 150, ferrous alloy.
 - 3. Butterfly Valves NPS 2-1/2: Class 150, ductile iron.
 - 4. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze (Horizontal Only). **Install only with owner written authorization**
 - 5. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron. (Horizontal Only). **Install only with owner written authorization**
 - 6. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Class 125 minimum.
 - 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Class 125, cast iron.
 - 8. Gate Valves, NPS 8 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
- D. Pumped Sanitary Waste and Storm Drainage Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, silicone bronze.
 - 2. Ball Valves, NPS 2-1/2 and larger: Class 150, ferrous alloy.
 - 3. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze (Horizontal Only)
 - 4. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron (Horizontal Only)
 - 5. Gate Valves, NPS 6 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
 - 6. Lift Check Valves: Vertical position.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for safe access by personnel with both hands simultaneously and provide separate support where necessary. Access shall include repair, and replacement of the valve, as well as the actuation.

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- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install quarter-turn valves so handles are in the open position is pointing in the direction of flow downstream of valve.
- F. Install valves in position to allow full stem movement.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level. **Install only with owner written authorization**
 - 2. Lift Check Valves: With stem upright and plumb.
- H. Install branch line isolation valves close to the branch connection to the main.
- I. Keyless stops are not acceptable. Provide handles on all valves.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section 22 05 15 "Common Work Results for Plumbing" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 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.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from the AHJ.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Carpenter & Paterson, Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Grinnell Corp.
 - 5. Tolco Inc.
 - 6. Hydra-Zorb Co.
- B. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dipped galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 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

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

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

- A. Manufacturers:
 - 1. Atkore Unistrut, Harvey, IL.
 - 2. Cooper B-Line Strut Systems, Inc., Highland, IL.
 - 3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 4. GS Metals Corporation, "Globe Strut."
- B. MFMA Manufacturer Metal Framing Systems:
 - 1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 3. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel
 - 7. Metallic Coating: No coating
 - 8. Paint Coating: Green epoxy, acrylic, or urethane
 - 9. Plastic Coating: PVC
- C. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel
7. Metallic Coating: No coating
8. Paint Coating: Green epoxy, acrylic, or urethane
9. Plastic Coating: PVC

2.5 FIBERGLASS STRUT SYSTEMS

- A. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.
1. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 2. Channels: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
 3. Channel Width: Selected for applicable load criteria.
 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers:
1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. Pipe Shields, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength, or ASTM C552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Empire Industries, Inc.
 - 3. Hilti, Inc.
 - 4. ITW Ramset/Red Head.
 - 5. MKT Fastening, LLC.
 - 6. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Zinc-coated or stainless steel.
 - 2. Outdoor Applications: Stainless steel.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Manufacturers:
 - 1. ERICO/Michigan Hanger Co.
 - 2. MIRO Industries.
- C. Compact Pipe Stand:
 - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - 3. Hardware: Galvanized steel or polycarbonate.
 - 4. Accessories: Protection pads.
- D. Low-Profile, Single-Base, Single-Pipe Stand:
 - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - 3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
 - 4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
 - 5. Pipe Supports: Roller or Strut clamps.
 - 6. Hardware: Galvanized steel.
 - 7. Accessories: Protection pads.

8. Height: 12 inches above roof.

E. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two galvanized steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: One adjustable-height, galvanized- or stainless-steel, pipe-support slotted channel or plate.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
8. Height: 36 inches above roof.

F. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
8. Height: 36 inches above roof

G. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE-POSITIONING SYSTEMS

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

2.10 EQUIPMENT SUPPORTS

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

2.11 MATERIALS

- A. Aluminum: ASTM B 221.

- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricated from ASTM A 36/A 36M carbon-steel shapes selected for loads supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

- F. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in cured concrete. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before placing concrete; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports for piping so as not to transmit loads and stresses from movement to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation is without vapor barrier. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least the length of the protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

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

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- C. Provide double nut arrangement on support rods which exert opposing forces on each other to secure the final adjustments in place.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Clean and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal as specified in Section 09 91 13 "Exterior Painting." Section 09 91 23 "Interior Painting." Section 09 96 00 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
 - 1. Contractor's Option 1: Provide felt-lined pipe insulator or elastomeric pipe clamp cushion so ferrous attachments are not in direct contact with copper tubing.
 - 2. Contractor's Option 2: Wrap copper tubing with not less than two layers of 10 mil thick black plastic tape extending to a minimum of 1 inch on each side of clamp.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation exists.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 requiring vertical adjustment, with steel-pipe base stanchion support and cast-iron floor flange.
 - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

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20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, as required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types for support of pipe risers NPS 3/4 to NPS 24:
1. Extension Pipe or Riser Clamps (MSS Type 8)
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are necessary for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is necessary.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement for limited headroom.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical supports and one trapeze member.

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- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications not specified in piping system Sections.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.

1.3 CLOSEOUT SUBMITTALS

- A. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Black anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: White
 - 3. Background Color: Black
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/2 inch for name of units if viewing distance is less than 24 inches, 1 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1" main lettering, 3/4 inch secondary lettering

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Rigid Carrier Pipe Labels: Use only MS-995 Maxilar™ Rigid Carrier Pipe Markers strapped to pipe with Type 316 ss banding.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size:
 - a. Pipe: <2.5" Letters: 3/4" high Pipe: 2.5 – 6" Letters: 1.5" high
 - b. Pipe: 8-10" Letters: 2.5" high Pipe: >10" Letters: 3.5" high

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting." Section 09 96 00 "High-Performance Coatings."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule: Comply with ANSI A13.1

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round
 - b. Hot Water: 2 inches, round
 - c. Low-Pressure Compressed Air: 2 inches], round.
 - d. High-Pressure Compressed Air: 2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - c. Low-Pressure Compressed Air: Natural
 - d. High-Pressure Compressed Air: Natural.
 - 3. Letter Colors:
 - a. Cold Water: White
 - b. Hot Water: White
 - c. Low-Pressure Compressed Air: White
 - d. High-Pressure Compressed Air: White

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.
 - 4. Roof drains and storm water piping subject to condensation.
 - 5. Sanitary drainage piping above grade subject to condensation.
 - 6. Plumbing equipment piping subject to condensation.

1.2 SUBMITTALS

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

1.3 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.
- B. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- C. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule(s)" for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that contact stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foam glass.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 4. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.

- b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
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. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Aeroflex USA, Inc.; Aero seal.
- b. Armacell LLC; Armaflex 520 Adhesive.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- d. K-Flex USA; R-373 Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
- b. Eagle Bridges - Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
- d. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

- A. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 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.
 5. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

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

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White or Color-code jackets based on piping system.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Sheet and roll stock ready for shop or field sizing.
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- D. Factory-Fabricated Fitting Covers:
 - 1. Same material, finish, and thickness as jacket.
 - 2. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3. Tee covers.
 - 4. Flange and union covers.
 - 5. End caps.
 - 6. Beveled collars.
 - 7. Valve covers.
 - 8. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
 - 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.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. 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.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples at edge 4 inches o.c.
 4. For below-ambient services, apply vapor-barrier mastic over staples.
 5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 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 below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.4 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.

- a. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

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

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:

1. Flexible Elastomeric: 1 inch thick.
 2. Cellular Glass with All Service Jacket: 1 inch thick.
 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 4. Polyolefin: 1 inch thick.
- B. Rainwater Piping (first 20 feet from roof drains and overflow drains):
1. Cellular Glass with All Service Jacket: 1 inch thick.
- C. Sanitary Drainage Piping subject to condensation:
1. Cellular Glass with All Service Jacket: 1 inch thick.
 2. Flexible Elastomeric Insulation with All Service Jacket: 1 inch thick.
- D. Plumbing Equipment Piping subject to condensation:
1. Cellular Glass with All Service Jacket: 1 inch thick.
 2. Flexible Elastomeric Insulation with All Service Jacket: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be the following:
1. 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.
- 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed or exposed:
1. PVC, Color-Coded by System: 20 mils thick.

END OF SECTION

SECTION 22 08 00

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Responsibilities in the Commissioning process, related to IECC and ASHRAE 90.1 compliance as well as for LEED certification.
- B. Commissioning Agent shall be or perform as if they are a 3rd party contracted by the Owner directly.
- C. Commissioning requires the participation of the General Contractor and all Division 22 subcontractors to ensure that all systems are operating in a manner consistent with the Contract Documents. All parties shall be familiar with the commissioning plan which is prepared by the Commissioning Authority (CxA) and shall execute all commissioning responsibilities.
- D. Commissioning shall include all new and existing equipment and systems serving the building that are identified in the Commissioning Plan.
- E. Building Controls: Controls Contractor, Plumbing Contractor, and BAS Network Integrator shall provide point to point commissioning and functional performance testing documentation to the Commissioning Agent prior to commencing building commissioning. In addition, Controls Contractor, Plumbing Contractor, and BAS Network Integrator shall provide controls commissioning documentation to the Commissioning Agent sufficient for the Commissioning Agent to prepare the Commissioning Plan. Controls Contractor, Plumbing Contractor, and BAS Network Integrator shall provide support for the Commissioning Agent and shall participate in commissioning activities as required to ensure that all BAS systems are operating properly.

1.2 DEFINITIONS

- A. BAS: Building automation system.
- B. Contractor: General Contractor.
- C. Cx: Commissioning, as defined in Section 01 91 13 "General Commissioning Requirements."
- D. CxA: Commissioning Authority.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

- F. TAB: Testing, adjusting, and balancing.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Plumbing Testing Technician.
- B. Construction Checklists: Draft construction checklists will be created by Contractor for CxA review.
- C. Construction Checklists: Material, installation, and performance test checklists for systems, assemblies, subsystems, equipment, and components to be part of the Cx process.
1. Plumbing piping, including the following:
 - a. Hot and cold piping, fittings, and specialties.
 - b. Hydronic pumps and motors.
 - c. Sleeves and sleeve seals.
 - d. Meters and gages.
 - e. General-duty and specialty valves.
 - f. Hangers and supports.
 - g. Heat tracing.
 - h. Vibration isolation.
 2. Water heaters, Booster Pumps, Water Softeners, Water Meters, Backflow Prevention Assemblies, and other plumbing equipment, including the following:
 - a. Supports and restraints.
 - b. Trim, accessories, and factory-installed controls.
 - c. Motors.
 3. Plumbing insulation, including the following:
 - a. Plumbing piping insulation.
 - b. Equipment insulation.
- D. Test equipment and instrumentation list, identifying the following:
1. Equipment/instrument identification number.
 2. Planned Cx application or use.
 3. Manufacturer, make, model, and serial number.
 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
 - a. Instrument or tool identification number.
 - b. Equipment schedule designation of equipment for which the instrument or tool is required.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level with knowledge of BAS, HVAC, electrical concepts, and building operations.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Plumbing Testing Technician Qualifications: Technicians to perform Plumbing construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate degree in plumbing systems similar field. Degree may be offset by three years' experience in servicing. Generally, required knowledge includes Plumbing systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of Plumbing equipment, assemblies, and systems.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- C. Testing Equipment and Instrumentation Quality and Calibration:
 - 1. Capable of testing and measuring performance within the specified acceptance criteria.
 - 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - 3. Be maintained in good repair and operating condition throughout duration of use on Project.
 - 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
 - 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Plumbing proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

1.5 RESPONSIBILITIES

- A. General, Plumbing, Controls/BAS network integrator, and Test & Balance (TAB) Contractors. The commissioning responsibilities applicable to each of the contractors are as follows (all references apply to commissioned equipment only):
1. Include and itemize the cost of commissioning in the contract price. Each contractor should include a minimum of an additional 20 person hours for performing commissioning activities, which shall include commissioning documentation, system performance verification, LEED documentation, O&M data, and training.
 2. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 3. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.
 4. Provide additional requested documentation for development of Pre-Functional, Functional, and Integrated Testing procedures.
 5. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
 6. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
 7. Assist the CxA in preparing the specific functional performance test procedures. Review test procedures to ensure feasibility, safety and equipment protection and provide necessary written limits to be used during the tests.
 8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup.
 9. During the startup and initial checkout process, execute the contractor related portions of the prefunctional checklists for all commissioned equipment.
 10. Perform and clearly document all completed startup and system operational checkout procedures for each system and each item of equipment, and complete pre-functional checklists and submit to CxA.
 11. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- and water-related systems.
 12. Provide skilled technicians to execute starting of equipment. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 13. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, and the Engineer, and retest the equipment.
 14. In collaboration with the CxA, perform Integrated Functional Testing of all systems and equipment.
 15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

16. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
 17. Provide training of the Owner's operating staff using expert qualified personnel, as specified. Provide comprehensive documentation of training, including hard copies, and video DVDs.
 18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- B. Plumbing Contractor. The responsibilities of the Plumbing mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startups for all Plumbing equipment.
 2. Assist and cooperate with the TAB contractor and CxA by:
 - a. Putting all Plumbing equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 3. Prepare a preliminary schedule for Division 22 system testing, flushing, and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.
 4. Notify the CxA, depending on protocol, when system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.
- C. Controls Contractor/BAS Network Integrator. The commissioning responsibilities of the controls contractor/BAS Network Integrator, during construction and acceptance phases in addition to those listed in (A) are:
1. Sequences of Operation Submittals. The submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - a. An overview narrative of the system describing its purpose, components, and function.
 - b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the FMS monitors only and what FMS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will require additional narrative).
 - e. Start-up sequences.
 - f. Warm-up mode sequences.
 - g. Normal operating mode sequences.
 - h. Unoccupied mode sequences.

- i. Shutdown sequences.
 - j. Capacity control sequences and equipment staging.
 - k. Temperature and pressure control: setbacks, setups, resets, etc.
 - l. Detailed sequences for all control strategies, e.g., optimum start/stop, staging, optimization, demand limiting, etc.
 - m. Effects of power or equipment failure with all standby component functions.
 - n. Sequences for all alarms and emergency shutdowns.
 - o. Seasonal operational differences and recommendations.
 - p. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - q. Schedules, if known.
 - r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
- 2. Control Drawings Submittal (coordinate with Division 23)
 - 3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
 - 4. Assist and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB or provide sufficient training for TAB to operate the system without assistance.
 - 5. Assist and cooperate with the CxA in the following manner:
 - a. Using a skilled technician who is familiar with this building's systems, and assisting the CxA as needed, in executing functional testing of the controls system.
 - 6. The controls contractor/BAS network integrator shall prepare a written plan indicating in a step-by-step manner, the test procedures that will be followed, checkout and adjust the control system prior to functional performance testing. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
 - a. System name.
 - b. List of devices.
 - c. Step-by-step testing procedures for each controller after installation, including:
 - (1) Process of verifying proper hardware and wiring installation.
 - (2) Process of downloading programs to local controllers and verifying that they are addressed correctly.

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- (3) Process of performing operational checks of each controlled component.
 - (4) Plan and process for calibrating valves, actuators, and all sensors.
 - (5) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.
 - e. A description of the instrumentation required for testing.
 - f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CxA and TAB contractor for this determination.
 - g. As a prerequisite for Functional Testing, provide a signed and dated certification to the CxA, upon completion of the checkout of each controlled device, equipment, and system, that all system programming is complete and in compliance with the Contract Documents.
- D. TAB Contractor - The duties of the TAB contractor, in addition to those listed in (A) are:
 - 1. Submit the outline of the TAB plan and approach for each system and component to the CxA, and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has familiarity with the control system.
 - 2. The submitted plan will include:
 - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
 - b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
 - c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.
 - d. List of all water flow, sound, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - e. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
 - f. The identification and types of measurement instruments to be used and their most recent calibration date.

1.6 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Plumbing systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Plumbing systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting and balancing reports.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for following Plumbing systems, assemblies, subsystems, equipment, and components:
 1. Plumbing systems, including the following:
 - a. Water heaters
 - b. Booster pumps
 - c. Sump pumps
 2. Water Softeners
 3. Water Meters
 4. Backflow Prevention Assemblies
 5. Domestic hot water circulating system
 - a. Circulating pumps.
 - b. Piping systems
 - c. Mixing valves

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft construction checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, the CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 TESTING PREPARATION

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

3.4 FUNCTIONAL AND INTEGRATED TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of testing shall include entire installations. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
- D. Tests will be performed using design conditions whenever possible, and simulated conditions may be used when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions. The CxA may direct that set points be altered when simulating conditions is not practical.
- E. If tests cannot be completed because of a deficiency, document the deficiency, and report it to the Owner. After deficiencies are resolved, reschedule tests.
- F. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.5 CX TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 22 shall compile and prepare documentation for all equipment and systems covered in Division 22 and deliver this documentation to the General Contractor (GC) for inclusion in the O&M manuals, according to this section and Division 01, prior to the training of owner personnel.
- C. The CxA shall receive a copy of the O&M manuals for review.
- D. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the CxA.

3.7 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination, scheduling, and completion. Coordinate with the Owner to obtain input for the training program.
- B. Plumbing Contractor. The plumbing contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of Plumbing equipment.
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
 6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 7. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
 8. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and preventative maintenance for all pieces of equipment.
 9. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
- C. Controls Contractor/BAS Network Integrator. The controls contractor/BAS network integrator shall have the following training responsibilities:
1. Provide the CxA with a training plan four weeks before the planned training.
 2. The controls contractor/BAS network integrator shall provide designated Owner personnel training on the control system in this facility. The intent is to instruct the Owner clearly and completely on all the capabilities of the control system.
 3. Training Manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the CxA. Copies of audiovisuals shall be delivered to the Owner.
 4. Training will be tailored to the needs and skill-level of the trainees.

5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
 6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.
 7. The controls contractor/BAS network integrator shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 8. There shall be three training sessions (Training Plan to be confirmed):
 - a. Training I. Control System. The first training shall consist of four (4) hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - b. Training II. Building Systems. The second session shall be held on-site for a period of four (4) hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - (1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed systems.
 - (2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, water savings strategies and set points that if changed will adversely affect water consumption, water accounting, procedures for obtaining vendor assistance, etc.
 - (3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will set-up trends in the presence of the trainer.
 - (4) Every screen shall be completely discussed, allowing time for questions.
 - (5) Use of keypad or plug-in laptop computer at the zone level.
 - (6) Use of remote access to the system via phone lines or networks.
 - (7) Setting up and changing an equipment controller.
 - (8) Graphics generation
 - (9) Point database entry and modifications
 - (10) Understanding DDC field panel operating programming (when applicable)
 - c. Training III. The third training will be conducted on-site six months after occupancy and consist of four (4) hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.
- D. The TAB contractor shall have the following training responsibilities:
1. TAB shall meet for 3 hours with facility staff after completion of TAB and instruct them on the following:

- a. Go over the final TAB report, explaining the layout and meanings of each data type.
- b. Discuss any outstanding deficient items in control or design that may affect the proper delivery of water.
- c. Identify and discuss any system components that are close to or are not meeting their design capacity.
- d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
- e. Other salient information that may be useful for facility operations, relative to TAB.

3.8 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the start-up and initial checkout plan and the filled-out start-up, and Pre-functional Checklists.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Piping joining materials.
 - 3. Encasement for piping.
 - 4. Dielectric fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated, include manufacturers name, materials of construction, and joining materials.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner at least two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

- A. See section 22 05 15 Common Work Results for Plumbing

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Polyethylene Sheet or tube.
- C. Color: Black or natural.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.

2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing according to CDA's "Copper Tube Handbook."
- C. Install shut-off valve and wall hydrant at each domestic water service entrance.
- D. Install domestic water piping level and plumb.
- E. Install cast iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall or rising thru slab on grade. Select number of interlocking rubber links required to make installation water-tight. Sleeves and mechanical sleeve seals are specified in Section 22 05 15 "Common Work Results for Plumbing."
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

- I. Install piping to permit valve servicing in a safe manner.
- J. Install piping free of sags and bends.
- K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty unless flanged connections are present.
- L. Install factory fabricated fittings for changes in direction and branch connections.

3.3 JOINT CONSTRUCTION

- A. Soldered joints NPS 2 and smaller above grade: Use ASTM B 813, water-flushable, leadfree flux, Sterling, or approved equal; ASTM B32, lead-free-alloy solder, Sterling premium grade or Silvabrite 100; and ASTM B828 procedure, unless otherwise indicated. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints below grade or 2-1/2" and Larger above grade: Use Silvaloy Silfos brazing rods which meet ASTM, ASW, Federal and military specification (BcuP-2) with melting temperature between 1350 degrees F and 1500 degrees F. Cored solder is not approved. Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment"
- B. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.
- H. Install additional supports at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.

3.5 CONNECTIONS

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

3.6 DIELECTRIC FITTING INSTALLATION

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

- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

- 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by the Owner.
- b. During installation, notify the Owner at least one day before inspection must be made. Perform tests specified below in presence of the Owner:
 - 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 the Owner to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If the Owner finds that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by the Owner.

- 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for two hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by the AHJ; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorized third party testing facility.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorized third-party testing facility.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

- B. Flanges and unions may be used for aboveground piping joints only.
- C. Under-building-slab, domestic water, building-service piping shall be:
 - 1. Soft copper tube, ASTM B 88, Type K without any joints in Polyethylene encasement.
- D. Aboveground domestic water piping, Sizes shall be:
 - 1. Hard copper tube, ASTM B 88, Type L ASTM B 88; wrought-copper, solder-joint fittings; and soldered or brazed joints.

3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use full port ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use full port globe valves for piping NPS 4 and smaller.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use spring check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Install shutoff valve close to water main and in serviceable location on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, on each water supply to plumbing fixtures with integral stops, and on each water supply to plumbing fixtures that do not have supply stops.
- D. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping or to provide freeze protection.
 - 1. Install hose end drain valves at low points in water main, risers and branches
- E. Install calibrated balancing valve in each hot water circulation return branch and discharge side of pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Section 22 11 19 "Domestic Water Piping Specialties."

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes
8. Hose bibbs.
9. Non-freeze hydrants.
10. Drain valves.
11. Water-hammer arresters.
12. Trap seal devices
13. Flexible connectors
14. Water Filters

B. Related Requirements:

1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 22 40 00 "Plumbing Fixtures" for water filters for water coolers or bottle fillers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, materials, finishes, dimensions, required clearances, methods of assembly of components, and piping and wiring connections.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Owner, and marked for intended use.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- D. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61. Mark "NSF-pw" on plastic piping components.
- B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

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

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Standard: ASSE 1001.
 - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 3. Body: Bronze.
 - 4. Inlet and Outlet Connections: Threaded.
 - 5. Finish: Rough bronze.

- B. Hose-Connection Vacuum Breakers:
 - 1. Standard: ASSE 1011.
 - 2. Body: Bronze, nonremovable, with manual drain.
 - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 4. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
 - 1. Standard: ASSE 1020.
 - 2. Operation: Continuous-pressure applications.
 - 3. Pressure Loss: 5 psig maximum, through middle third of flow range.
 - 4. Size: See plans
 - 5. Design Flow Rate: Refer to plans
 - 6. Selected Unit Flow Range Limits: Refer to plans.
 - 7. Pressure Loss at Design Flow Rate: Refer to plans.
 - 8. Accessories:
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
 - 1. Standard: ASSE 1035.
 - 2. Size: NPS 1/4 or NPS 3/8 matching faucet size.
 - 3. Body: Bronze.
 - 4. End Connections: Threaded.
 - 5. Finish: Chrome plated.
- E. Spill-Resistant Vacuum Breakers:
 - 1. Standard: ASSE 1056.
 - 2. Operation: Continuous-pressure applications.
 - 3. Size: Refer to plans
 - 4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturer/Model: Provide Watts Model LF909QT-S.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: Refer to plans.
 - 5. Size: Refer to plans.
 - 6. Design Flow Rate: Refer to plans.
 - 7. Selected Unit Flow Range Limits: Refer to plans.
 - 8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 10. Configuration: Designed for horizontal, straight-through flow.
 11. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturer/Model: Provide Wilkins Model 350A.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications unless otherwise indicated.
 4. Size: Refer to plans.
 5. Design Flow Rate: Refer to plans.
 6. Selected Unit Flow Range Limits: Refer to plans.
 7. Pressure Loss at Design Flow Rate: Refer to plans.
 8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 10. Configuration: Designed for horizontal, straight-through flow.
 11. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- C. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:
1. Manufacturer/Model: Provide Wilkins Model 350DA.
 2. Standard: ASSE 1047 and is FM Global approved or UL listed.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: Refer to plans
 5. Size: Refer to plans
 6. Design Flow Rate: Refer to plans
 7. Selected Unit Flow Range Limits: Refer to plans.
 8. Pressure Loss at Design Flow Rate: Refer to plans
 9. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
 10. End Connections: Flanged.
 11. Configuration: Designed for horizontal, straight-through flow.
 12. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

- c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Beverage-Dispensing-Equipment Backflow Preventers:

- 1. Manufacturer/Model: Provide Watts Model 009QT-S.
- 2. Standard: ASSE 1022.
- 3. Operation: Continuous-pressure applications.
- 4. Size: NPS 1/4 or NPS 3/8.
- 5. Body: Stainless steel.
- 6. End Connections: Threaded.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc. Water Products Division
 - b. Zurn Plumbing Products Group; Wilkins Division.
- 2. Standard: ASSE 1003.
- 3. Pressure Rating: Initial working pressure of 150 psig.
- 4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
- 5. Valves for Booster Heater Water Supply: Include integral bypass.
- 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valve:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc. Water Products Division
 - b. Zurn Plumbing Products Group; Wilkins Division.
- 2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
- 3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
- 4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Pattern: Angle or Globe valve design.
 - b. Trim: Stainless steel.
- 5. Design Flow: Refer to plans
- 6. Design Inlet Pressure: Refer to plans.
- 7. Design Outlet Pressure Setting: Refer to plans
- 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts
 - b. Bell and Gossett
 - c. Nibco
 - d. Griswold Controls
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Lead Free Bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary Service, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley
 - b. Watts Industries
 - c. Symmons Industries
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted or cabinet type as indicated on plans, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to Plans
9. Tempered-Water Design Flow Rate: Refer to Plans
10. Selected Valve Flow Rate at 45-psig Pressure Drop: Refer to Plans
11. Pressure Drop at Design Flow Rate: Refer to Plans
12. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Point-of-Use Water Tempering Valves:

1. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.

6. Finish: Rough or chrome-plated bronze.

C. Multiple Shower Service, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley.
 - b. Watts Industries Co.
 - c. Symmons Industries, Inc.
2. Standard: ASSE 1069.
3. Pressure Rating: 125 psig.
4. Type: Cabinet-type, thermostatically controlled, pressure-balanced, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, outlet thermometer, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting: 120 deg F.
10. Valve Finish: Rough bronze.
11. Piping Finish: Copper.
12. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Full port ball valve with hose end/cap

2.9 OUTLET BOXES

A. Ice Machine and Coffee Maker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company
 - b. Guy Gray Manufacturing

- c. Symmons Industries, Inc
- d. Zurn Industries
- 2. Mounting: Recessed.
- 3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
- 4. Supply Shutoff Fitting: NPS 1/2 ball valve with end sized to match equipment connection.

2.10 HOSE BIBBS

- A. Hose Bibbs: Woodford 24P or approved equal by watts, nibco or legend
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig.
 - 7. Vacuum Breaker: Integral or non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 9. Finish for Service Areas: Chrome or nickel plated].
 - 10. Finish for Finished Rooms: Chrome or nickel plated.
 - 11. Operation for Equipment Rooms: Wheel handle or operating key.
 - 12. Operation for Service Areas: Wheel handle
 - 13. Operation for Finished Rooms: Wheel handle.
 - 14. Include operating key with each operating-key hose bibb.
 - 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.11 NON-FREEZE HYDRANTS

- A. Non-freeze Wall Hydrants:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Woodford Manufacturing Company model B65 or comparable product by one of the following:
 - a. Acorn Products
 - b. Watts Industries
 - c. Zurn Industries
 - 2. Standard: ASME A112.21.3M for concealed outlet, self-draining wall hydrants.
 - 3. Pressure Rating: 125 psig.
 - 4. Operation: Loose key.
 - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 6. Inlet: NPS 3/4 or NPS 1.

7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze
10. Nozzle and Wall-Plate Finish: Verify with arch
11. Flush or recessed mount. Verify with arch
12. Operating Keys(s): One with each wall hydrant.

B. Non-freeze Roof Hydrants:

1. Basis of Design Product: Subject to compliance with requirements, provide Woodford Manufacturing Company model B65 or comparable product by one of the following:
 - a. Acorn Products
 - b. Watts Industries
 - c. Zurn Industries
2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 100 psig.
4. Operation: Lever style handle.
5. Casing: Galvanized pipe.
6. Inlet: NPS 1.
7. Outlet: Garden-hose thread connection with dual check valve backflow preventer.
8. Boot: EPDM boot covers top of hydrant support.
9. Roof Support: Cast iron deck flange.

C. Non-freeze Yard Hydrants:

1. Basis of Design Product: Subject to compliance with requirements, provide Woodford Manufacturing Company model B65 or comparable product by one of the following:
 - a. Acorn Products
 - b. Watts Industries
 - c. Zurn Industries
2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Lever style handle.
5. Casing: Galvanized pipe.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Garden-hose thread connection with dual check valve backflow preventer.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for full-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.

4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company
 - b. Jay R. Smith Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc
 - e. Zurn Plumbing Products Group
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.

2.14 TRAP-SEAL DEVICES

A. Trap-Seal Device:

1. Manufacturers: Provide the SureSeal by Rectorseal.
2. Standard: ASSE 1072.
3. Body: ABS.
4. Diaphragm: EPDM.

2.15 FLEXIBLE CONNECTORS

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

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.16 WATER FILTERS

- A. Inline water filter assembly with fixed cartridge holder and replaceable cartridges. Provides particulate reduction, chlorine taste & odor reduction, cyst reduction, scale control, and bacteria control. NSF/ANSI Standard 53 certified to reduce Cryptosporidium and Giardia by mechanical means.
- B. Manufacturer/Model: Pentair Model Insurice Single I20002 System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All equipment and components shall be installed in accordance with their listing and manufacturer's published installation instructions.
- B. Refer to Section 22 05 15 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- C. Backflow Preventers: 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 the AHJ.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple airbreaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- D. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- E. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- F. Balancing Valves: Install in locations where they can easily be adjusted.
- G. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.

- H. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump. Install with full port ball valve (upstream) to enable serve
- I. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 53 "Miscellaneous Rough Carpentry."
- J. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check, backflow-prevention assemblies.
 - 4. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
 - 5. Double-check, detector-assembly backflow preventers.
 - 6. Water pressure-reducing valves.
 - 7. Calibrated balancing valves.
 - 8. Primary, thermostatic, water mixing valves.
 - 9. Primary water tempering valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventers, double-check, backflow-prevention assemblies and double-check, detector-assembly backflow preventers according to AHJ and the device's reference standard.

- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Provide report indicating all adjustments made and the results.

END OF SECTION

SECTION 22 11 23

DOMESTIC WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Product Data: For each packaged booster pump assembly specified. Include certified performance curves with operating points plotted on pump curves; and rated capacities of selected models, furnished specialties, dimensioned drawings, and accessories.
- B. Operation and maintenance data.

1.2 QUALITY ASSURANCE

- A. The packaged pumping system manufacturer must also manufacture the control panel used on the system and be listed by Underwriters Laboratories as an UL508a Control Panel Shop.
- B. The packaged pumping system manufacturer must also be listed under UL QCZJ standard for "Packaged Pumping Systems."
- C. The packaged pumping system shall be flow tested and pre-set to conditions specified.
- D. The packaged system shall be NSF/ANSI 61 and 372 certified.

PART 2 - PRODUCTS

2.1 VARIABLE SPEED, MULTIPLEX BOOSTER PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. QuantumFlo
 - 2. Advanced Mechanical Technologies
 - 3. SynchroFlo
- B. Provide a unitary pre-packaged Domestic Water Pressure Booster Pumping System per engineering data flow and head requirements. The entire system shall be listed under UL QCZJ, "Packaged Pumping System" requirements. The entire pump system package shall be listed with NSF/ANSI 61 and 372 certifications.
- C. System shall be comprised of the following components:

1. Pumps shall be of the vertical multistage centrifugal design and NSF/ANSI 61 certified with Annex G or additionally NSF/ANSI 372 certified. The impellers, pump shaft, diffuser chambers, outer discharge sleeve rings and seal rings retainers shall be constructed of stainless steel.
2. Motors shall be High Efficiency, Class F insulated. The motors shall be suitable for the voltage, frequency, phasing, and enclosure as indicated in the pump schedule on the project plan set.
3. Structural Elements: The entire system shall be factory skid mounted on a minimum; 304 stainless-steel structural support frame with rubber vibration isolators.
4. Valves: Valves shall be full port Stainless Steel ball valve design for valve sizes 2" and smaller, and sometimes up to 3". Valves shall be cast iron, epoxy coated lever operated, grooved end type butterfly valves, with EPDM encapsulated disc, and Stainless Steel shaft for valve sizes 2 1/2" and larger. Valves must be rated for maximum pressure service for the system.
5. Check Valves: Check valves shall be lead free bronze body, NPT thread connection for valve sizes up to 2" and flanged sized 2-1/2" and larger with ANSI/NSF 61 and 372 certifications. Check valves must be rated for maximum pressure service for the system and Low Lead certified.
6. Automatic City Water Bypass: If on schedule, system shall include factory-installed bypass with check valve allowing flow from suction to discharge without manual operation.
7. Control Panel and Touch Screen Interface: The pumping system control panel shall incorporate the following elements, and criteria:
 - a. The pump controllers, and its components including VFDs shall be housed in a Type 12, UL listed, ventilated, control enclosure unless specified otherwise. The controller shall have a main power disconnect switch, with enclosure door interlock, which shall require opening the disconnect switch before the control enclosure may be opened. The system shall provide for a single point electrical connection, with power, both primary, and secondary to be deactivated by opening the main disconnect switch.
 - b. The entire controller shall be UL 508A listed for Enclosed Industrial Control Panels, and have UL listed devices meeting IEC 529 "Touch-Safe" design, which shall eliminate bare handed shock hazard while the controller is fully powered. Primary branch and control circuits shall include circuit breakers (fuses are unacceptable) compliant with UL 489. Secondary control circuit wiring shall be 24 volts, AC/DC and the cabinet door front shall feature a touchscreen LCD interface with alarm logging and real-time clock.
 - c. The controller shall utilize a programmable logic controller, which shall provide pump staging, and timing functions. Alarm conditions shall have audible and visual indicators, with time delayed proof of condition automatic reset and automatic alarm condition and recovery logging accessible through the LCD user interface. The PLC shall provide for automatic alternation between equal pumps.
 - d. The control panel shall include the following features:
 - 1) Variable Speed Drive of PWM output design with IGBT inverter technology and voltage control of the output PWM waveform. The

minimum VFD efficiency shall be 95% for 2 HP and below, 97% for 3HP and above.

- 2) Three phase lightning protection for entire control panel.
- 3) PI control shall be performed by the PLC.
- 4) Controller PI operation shall stage pumps on and equalize pump speed within 60 seconds.
- 5) PLC shall indicate if VFD power is off and will sound alarm if the pump is in auto or hand mode.
- 6) System program shall be capable of adjusting from duplex, triplex or quadplex configuration to other without re-programming the controller for future pump applications.
- 7) Soft System Start, provides controlled filling of pipes, preventing water hammer, burst water pipes and overall stress to the plumbing system. The pressure setpoint shall become current pressure when a pump comes online below the field-adjustable Soft System Start pressure, and it shall increase by 5psi at a field-adjustable interval of seconds.
- 8) The individual pump Hand-Off-Auto switches shall be accessible.
- 9) End of Curve Detection, used to detect line breaks.
- 10) Low Suction and High System protection utilizing individual suction and discharge stainless steel pressure transducers.
- 11) Modbus RTU Serial communications between PLC and VFDs. Should Modbus failure occur, the PLC shall be capable of operating the system without communications.
- 12) Suction and Discharge pressure trending with display.
- 13) Automatic alarm logging feature with time stamp and recovery log.
- 14) Temperature sensor and system over temperature protection.
- 15) Best Efficiency Point Optimization, stages lag pumps to maintain maximum system efficiency.
- 16) Control components shall be UL Listed, or recognized devices.
- 17) The controller shall be UL 508 Listed, and in accordance with NFPA 70 (NEC) and NFPA 79.
- 18) The PLC shall be capable of manual operation via the touchscreen interface for each VFD. The alarm log shall log the date and time of each manual operation.
- 19) An interface module capable of communicating with the Owner's Building Management System (BMS).

NOTE: Components shall be of standard manufacture. Components shall bear the manufacturer's original nameplate date, and source, such that repair parts may be readily available at reasonable cost to the owner.

8. Pump Sequencing: Pump sequencing shall be initiated and controlled via the programmable logic controller automatically to include the following features: Lead pump alternation after every cycle, sequential alternation of lag pumps, sequence shifting that adjusts the program if pump is disabled and "soft start" which reduces surges on power loss automatic restarts and field adjustable parameters.
9. Pressure Regulation: Pressure regulation is provided via the variable frequency drive controllers, with PID control. No other pressure regulators are required. In the event of drive failure, the next drive in the sequence shall start automatically and the failed drive shall indicate a fault condition. There will be no failure of the

major control components which will compromise the building pipe pressure ratings.

10. Fabrication:
 - a. Headers, nipples, and welded attachments to the headers shall be 304L stainless steel materials.
 - b. Welding shall be in accordance with section IX of the ASME Boiler and Pressure Vessel code and shall be performed by welders qualified under that standard.
 - c. The completed system shall be hydrostatically tested after appurtenances have been installed to a minimum of 1.5 times the specified system working pressure.
 - d. Each pump shall have an individual resilient seated non-slam type check valve on each pump immediately downstream of the pump discharge.
 - e. Stainless steel fabrication shall be brushed or polished.
 11. Start-up:
 - a. Initial factory start-up and owner training shall be performed by a qualified factory trained technician. A factory certified start-up report dated and signed by the factory trained technician must be provided to the Owner.
 12. Parts: A complete listing of parts and equipment for the system shall be listed using the original manufacturer's model, and serial numbers, and source information.
 13. Owner Training: The owner instruction, and training shall include, but not be limited to the following:
 - a. Training in the replacement of the motor, mechanical seals, and pump impeller.
 - b. Proper operation of the system, troubleshooting, alarm, and reset features.
 14. On-Site Factory Warranty: Provide 24-month warranty for equipment. Warranty shall be a "Factory On-Site" Warranty which includes both time and materials in the event of a failure. Warranty will be performed by the manufacturer or a trained factory representative.
- D. The entire system shall be factory skid mounted on a structural square tube support frame. Suction and discharge connections shall be flanged, complete with pressure gauges, located on the control panel.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for packaged booster pumps. Refer to Division 22 Section 22 05 15 "Common Work Results for Plumbing."
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.

DOMESTIC-WATER PACKAGED BOOSTER PUMPS

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4. Install anchor bolts to elevation required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Section 03 30 53 "Miscellaneous Cast in Place Concrete."

3.2 BOOSTER PUMP INSTALLATION

- A. Install packaged booster pumps level with rubber vibration isolation pads on concrete bases with access for periodic maintenance including removal of pumps, motors, impellers, couplings, and accessories.
 1. Do not dismantle packaged booster pumps or remove individual components.
- B. Support connected domestic water piping independently, so weight of piping is not supported by packaged booster pumps.
- C. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Connect domestic water piping to packaged booster pumps. Install suction and discharge pipe equal to or greater than size of unit suction and discharge headers.
 1. Install union or flanged connections on pump suction and discharge headers at connection to domestic water piping.
 2. Install piping adjacent to packaged booster pumps to allow service and maintenance.
- E. Ground equipment according to Division 26 Section 26 25 06 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- G. Install identifying equipment labels and equipment signs on booster pumps. Labeling and identification materials are specified in Division 22 Section 22 05 15 "Identification for Plumbing Piping and Equipment."
- H. Install pumps complete with accessories as shown or described on the construction documents.
- I. Install pumps with adequate working clearance around components and accessories.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged booster pumps. Refer to Division 01.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.
 - 2. Copper tube and fittings.
 - 3. PVC pipe and fittings.
 - 4. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner at least three days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 and CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufactures: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky
 - b. Clamp-All Corp
 - c. Tyler Pipe
 - d. Mission Rubber Company; A Division of MCD Industries
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
 - 4. NPS 1-1/2 to NPS 4: 3-inch wide shield with 4 bands
 - 5. NPS 5 to NPS 10: 4-inch wide shield with 6 bands

2.3 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- 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.
- E. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 2. Shielded, Non-pressure Transition Couplings:
 - a. Anaco-Husky SD4200 or equal
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension bands and tightening mechanisms on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - 3. Pressure Transition Couplings:
 - a. Standard: AWWA C219.
 - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: Manufacturer's standard
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
 - 1. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 2. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

SANITARY WASTE AND VENT PIPING

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3. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
4. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F Insert pressure and temperature.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."
- B. The work site within the interior of a building shall be always maintained in a neat and safe condition. Excavated soils shall be set aside or removed from the space to maintain safe access to the work by the contractors and inspectors.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install factory fabricated fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. 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.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drainage pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. 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."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install underground PVC piping according to ASTM D 2321.

- P. Transition from underground PVC piping within 6" above grade to cast iron soil piping for waste and vent.
- Q. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- R. Install force mains at elevations indicated.
- S. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by the Owner.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors in accordance with Section 22 05 15 "Common Work Results for Plumbing."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors in accordance with Section 22 05 15 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- E. Plastic, Non-pressure Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with slight differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.
 - 3. In Force Main Piping: Fitting-type transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 Use dielectric flanges, flange kits.
 - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 22 05 23 "General Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install full-port ball valve for piping NPS 2 and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.

3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by the Owner.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify the Owner before inspection must be made. Perform tests specified below in presence of the Owner.
 - 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 the Owner to observe tests specified below and to ensure compliance with requirements.
 - B. Reinspection: If the Owner finds 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 the Owner.
 - D. Test sanitary waste and vent piping as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test with diagram indication portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water Apply not less than 10-foot head of water, except within the highest ten feet of the vent piping.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
 - E. Test force-main piping as follows:
 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for two hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.
- 3.10 CLEANING AND PROTECTION
- A. Clean interior of piping. Remove dirt and debris as work progresses.
 - B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - C. Place plugs in ends of uncompleted piping at end of day and when work stops.

- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste and vent piping sizes shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
- C. Underground and 6 inches above slab on grade, soil, waste, and vent piping sizes shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Couplings: Non-pressure transition couplings.
- D. Aboveground sanitary-sewage force mains shall be the following:
 - 1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following sanitary drainage piping specialties:
 - 1. Floor drains and floor sinks.
 - 2. Miscellaneous sanitary drainage piping specialties.
 - 3. Grease Traps and Grease Interceptors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, materials, finishes, dimensions, required clearances, operating characteristics, and accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data for the following:
 - 1. Grease traps.
 - 2. Grease interceptors

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Floor Cleanout:
 - 1. Manufacturers:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M, cleanouts.
 - 3. Size: Same as connected branch.
 - 4. Type: Medium-duty, adjustable housing.

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5. Body or Ferrule Material: Cast iron.
6. Closure: ABS or PVC plug with straight threads.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Nickel-bronze.
9. Frame and Cover Shape: As scheduled.

B. Top-Loading Classification: Medium Duty Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron soil-pipe test tee.
4. Closure Plug: Countersunk ABS.
5. Closure Plug Size: Same as cleanout size.
6. Wall Access: Round, flat, stainless-steel cover plate with screw.

C. Wall Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron .
4. Closure: Countersunk ABS.
5. Closure Plug Size: Same as cleanout size.
6. Wall Access: Round, flat, stainless-steel cover plate with screw.

2.2 Floor Drains and Floor Sinks:

A. Cast-Iron Floor Drains; Equipment Rooms and Unfinished Areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product specified on drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: As scheduled.
6. Anchor Flange: As scheduled.
7. Clamping Device: As scheduled.
8. Coating on Interior and Exposed Exterior Surfaces: Epoxy.
9. Sediment Bucket: Shallow-type.
10. Top or Strainer Material: Ductile Iron.
11. Top of Body and Strainer Finish: Ductile Iron.

12. Top Shape: As scheduled.
13. Dimensions of Top or Strainer: As scheduled..
14. Top Loading Classification: Heavy Duty.
15. Funnel: Not required.
16. Inlet Fitting: Gray iron, with threaded inlet.

B. Cast-Iron Floor Drains; Finished Areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product specified on drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: As scheduled.
8. Coating on Interior and Exposed Exterior Surfaces: Epoxy.
9. Sediment Bucket: Not required.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Nickel bronze.
12. Top Shape: As scheduled.
13. Dimensions of Top or Strainer: As scheduled.
14. Top Loading Classification: Medium Duty.
15. Funnel: Not required.

C. Cast-Iron Shower Drain (above grade):

1. Basis-of-Design Product: Subject to compliance with requirements, provide product specified on drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required in surfaces with a waterproof membrane.

8. Coating on Interior and Exposed Exterior Surfaces: Epoxy.
9. Sediment Bucket: Not required.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Nickel bronze.
12. Top Shape: As scheduled.
13. Dimensions of Top or Strainer: As scheduled.
14. Top Loading Classification: Medium Duty.
15. Funnel: Not required.

D. Shower Drain (slab on grade):

1. Basis-of-Design Product: Subject to compliance with requirements, provide a Sioux Chief Series 822 or a comparable product by one of the following:
 - a. Sioux Chief
 - b. Oatey
 - c. Watts Drainage Products Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor.
4. Body Material: PVC.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required in surfaces with a waterproof membrane.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: As scheduled.
11. Dimensions of Top or Strainer: As scheduled.
12. Top Loading Classification: Medium Duty.

E. Cast-Iron Floor Sink; Equipment Rooms and Unfinished Areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product specified on drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Clamping Device: Required in surfaces with a waterproof membrane.
6. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
7. Strainer: Dome-type.
8. Grate Material: Cast-iron.
9. Grate Finish: Acid-resistant enamel.

10. Top Shape: As scheduled.
11. Grate Coverage: 1/2.
12. Dimensions: 12 inch square top with 10 inch deep sump.
13. Top Loading Classification: Light Duty.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. 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.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

D. Air-Admittance Valves (Permission of Owner is required):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Co., Inc.
 - b. Studor, Inc.
2. Description: Plastic housing with mechanically-operated sealing diaphragm, designed to admit air into vent piping and to prevent transmission of sewer gas into building.
3. Stack Vent Valve:
 - a. Standard: ASSE 1050.
 - b. Application: Termination of vent stack inside of building.
4. Fixture Vent Valve:
 - a. Standard: ASSE 1051.
5. Application: Connection to a vent serving a single fixture.

2.4 GREASE TRAPS

A. Grease Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Rockford Sanitary Systems, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.
3. Plumbing and Drainage Institute Seal: Required.
4. Body Material: Cast iron or steel.
5. Interior Lining: Corrosion-resistant enamel.
6. Exterior Coating: Corrosion-resistant enamel.
7. Flow Rate: See Drawings.
8. Grease Retention Capacity: See Drawings.
9. Inlet and Outlet Size: See Drawings.
10. End Connections: Flanged, hub, threaded
11. Cleanout: Integral.
12. Mounting: Above floor or recessed, flush with floor as indicated on Drawings.
13. Flow-Control Fitting: Required.
14. Operation: Manual cleaning.

2.5 GREASE INTERCEPTORS

A. Grease Interceptors: Precast concrete complying with ASTM C 913. As approved by Maricopa County.

1. Include manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
 - a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection, with mechanical seals. See common work results
4. Grade Rings: Reinforced-concrete rings, 3- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous; 24-inch ID riser with 4-inch minimum width flange and 26-inch diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.

- c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR".
- B. Capacities and Characteristics:
 - 1. Length by Width by Depth: as determined by manufacturer.
 - 2. Number of Compartments: Three.
 - 3. Retention Capacity: as scheduled on plans.
 - 4. Inlet and Outlet Pipe Size: per plans.
 - 5. Installation Position: Underground with manhole riser to grade.
- C. Acceptable Manufacturers:
 - 1. Jensen Interceptor
 - 2. U.S. Concrete Precast Group

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section 22 05 15 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- C. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- D. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- E. Install grease traps, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
- F. Install precast-concrete interceptors per manufacturer's instructions. Perform excavation and backfill per MAG Specification 601. Set level and plumb.

- G. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade
- H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- I. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Trap: Connect inlet and outlet to unit and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease trap.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

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

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.
 - 2. PVC pipe and fittings.
 - 3. Specialty pipe and fittings.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AB&I
 - b. Tyler

2. Marked with CISPI collective trademark and NSF certification mark.
3. Standard: ASTM A 888 and CISPI 301.
4. ASTM a 74, service weight

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clampall Model Hi Torque 125
 - b. Husky Model SD4000
2. Standard: ASTM C 1540.
3. Description: ASTM C 1540 assembly consisting of type 304 Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Listed by IAPMO and complying with FM1680 Class 1.
 - a. NPS 1-1/2" to NPS 4: 3-inch-wide shield with 4 bands
 - b. NPS 5 and larger: 4-inch wide shield with 6 bands

2.2 SOLID WALL PVC PIPE AND FITTINGS

- A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.
- 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.
- E. Solvent Cement: ASTM D 2564.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
4. Pressure Transition Couplings:

- a. Standard: AWWA C219.
- b. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
- c. Center-Sleeve Material: Manufacturer's standard
- d. Gasket Material: Natural or synthetic rubber.
- e. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install factory fabricated fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
 - 1. Do not change direction of flow more than 90 degrees.
 - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert.
- K. Install piping at the following minimum slopes unless otherwise indicated:
 1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
- L. 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."
- M. Install underground PVC piping according to ASTM D 2321.
- N. Plumbing Specialties:
 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."
 2. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for sleeves specified in Section 22 05 15 "Common Work Results For Plumbing."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 22 05 15 "Common Work Results For Plumbing."

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.
- C. Joint Restraints and Sway Bracing:
 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

- a. Provide axial restraint for pipe and fittings 5 inches > and larger, upstream and downstream of changes in direction, branches, and changes in diameter greater than two pipe sizes.
- b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of changes in direction 45 degrees and greater.
- c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of changes in direction and branch openings.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting and coupling.
- D. Support vertical cast-iron piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Comply with requirements for cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

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

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
- C. Piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

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

3.10 PIPING SCHEDULE

- A. Aboveground storm drainage piping: Hubless, cast-iron soil pipe and fittings; CISPI, heavy duty hubless-piping couplings; and coupled joints.
- B. Underground and 6 inches above slab on grade storm drainage piping: PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
 - 4. Trench drains.
 - 5. Channel drainage systems.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Manufacturers: Subject to requirements, provide products, manufactures offering products that may be incorporated into the Work include, but are not limited to, the following
 - 1. Zurn Plumbing Products Group
 - 2. J. R. Smith
 - 3. Wade
 - 4. Watts
- B. Cast-Iron, General-Purpose Roof Drains:
 - 1. Standard: ASME A112.6.4.
 - 2. Body Material: Cast iron
 - 3. Dimension of Body: Nominal 14-to 22-inch diameter.
 - 4. Combination Flashing Ring and Gravel Stop: Required.
 - 5. Flow-Control Weirs: Optional

6. Outlet: Bottom
7. Extension Collars: Optional
8. Underdeck Clamp: Required unless waived in writing by Owners PM.
9. Expansion Joint: Optional
10. Sump Receiver Plate: Not required
11. Dome Material: Aluminum or Cast iron as scheduled.
12. Perforated Gravel Guard: Not required.
13. Vandal-Proof Dome: Not required.
14. Water Dam: Not Required

C. Metal, Cornice and Gutter Roof Drains:

1. Standard: ASME A112.6.4.
2. Body Material: Cast iron
3. Dimension of Body: Nominal 6-inch diameter.
4. Outlet Type: Threaded
5. Dome Material: Bronze
6. Wire Mesh: Stainless steel or brass over dome
7. Vandal-Proof Dome: Not required

D. Metal, Parapet Roof Drains:

1. Standard: ASME A112.6.4.
2. Body Material: Cast iron.
3. Outlet: Back or Angle
4. Grate Material: Bronze or Nickel-bronze alloy
5. Wire Mesh: Not required.
6. Vandal-Proof Grate: Not required.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors :

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Description: Manufactured, ASTM A48/A48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

STORM DRAINAGE PIPING SPECIALTIES

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2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected branch.
3. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head ABS plug.
5. Closure Plug Size: Same as cleanout size.

B. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:
 - a. Plastic, ABS.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as cleanout size.
5. Wall Access: Round, deep, chrome-plated bronze, flat, chrome-plated brass or stainless-steel cover plate with screw as scheduled.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover as scheduled.

C. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk ABS
5. Closure Plug Size: Same as cleanout size.

2.4 TRENCH DRAINS

A. Trench Drains:

1. Standard: ASME A112.6.3.
2. Body Material: Cast iron
3. Flange: Not Required
4. Clamping Device: Optional
5. Outlet: Bottom or End.
6. Grate Material: Ductile iron or stainless steel as scheduled.
7. Grate Finish: Non-painted, resistant to high traffic
8. Dimensions of Frame and Grate: Refer to plans:
9. Top-Loading Classification: Heavy Duty or Medium Duty as scheduled.

2.5 CHANNEL DRAINAGE SYSTEMS

A. Narrow, Sloped-Invert, Polymer-Concrete, Channel Drainage Systems:

1. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps.
 - 1) Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated.
 - 2) Include extension sections necessary for required depth.
 - 3) Dimensions: 5-inch inside width and 9-3/4-inch inside depth. Include number of units required to form total lengths indicated.
 - 4) Frame: Galvanized steel or cast iron for grates
 - b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: Ductile iron
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections
 - c. Covers: Solid ductile or cast iron of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Narrow, Level-Invert, Polymer-Concrete, Channel Drainage Systems:

1. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps.
 - 1) Include rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - 2) Dimensions: 5-inch inside width and 9-3/4-inch inside depth. Include number of units required to form total lengths indicated.
 - 3) Frame: Galvanized steel or cast iron for grates.
 - b. Grates: Manufacturer's designation "heavy or medium duty as scheduled," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: Ductile iron
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections
 - c. Covers: Solid ductile or cast iron of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

- C. Wide, Level-Invert, Polymer-Concrete, Channel Drainage Systems:
1. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps.
 - 1) Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - 2) Dimensions: 8-inch inside width and 13-3/4-inch inside depth. Include number of units required to form total lengths indicated.
 - 3) Frame: Galvanized steel or cast iron for grates
 - b. Grates: Manufacturer's designation "heavy or medium duty as scheduled," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: Ductile iron
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Covers: Solid ductile or cast iron of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Install expansion joints, if indicated, in roof drain outlets.
 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.

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- 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
- 4. Locate cleanouts at base of each vertical storm piping conductor.
- F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- G. Install test tees in vertical conductors and near floor.
- H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- I. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- J. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- K. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
 - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

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

END OF SECTION

STORM DRAINAGE PIPING SPECIALTIES

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SECTION 221513

GENERAL SERVICE COMPRESSED AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Piping.
 - 2. Pipe joining materials.
 - 3. Flexible pipe connectors.
 - 4. Dielectric fittings.
 - 5. Specialties.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Pipe joining materials.
 - 3. Pressure regulators. Include rated capacities and operating characteristics.
 - 4. Automatic drain valves.
 - 5. Filters. Include rated capacities and operating characteristics.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.

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2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

B. Copper Tube: ASTM B 88, Type L seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

1. ASME B16.21, nonmetallic, flat, full-face, asbestos free, 1/8 inch maximum thickness.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.3 VALVES

A. Metal Ball, Butterfly, Check and Gate Valves: Comply with requirements in Division 22 Section "General Duty Valves for Plumbing Piping."

2.4 FLEXIBLE PIPE CONNECTORS

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

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.

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

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.5 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, pilot-operated direct acting, spring-loaded manual pressure-setting adjustment, and rated for 300 psig inlet pressure, unless otherwise indicated. Speedaire ZM Series or approved equal.
- C. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 300 psig minimum inlet pressure, unless otherwise indicated. Speedaire DK Series or approved equal.
- D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 300 psig minimum working pressure, capable of automatic discharge of collected condensate. Speedaire Model 6Z948B or approved equal.
- E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated, 250 psig, 150F temperature, 1 micron filtration, Speedaire GN Series or approved equal.
- F. Particulate Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration and drain cock, 5 micron, 290 psig, 175F temperature, Speedaire GN Series or approved equal.

2.6 QUICK COUPLINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aeroquip Corporation; Eaton Corp.
 2. Bowes Manufacturing Inc.
 3. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
 4. Schrader-Bridgeport; Amflo Div.
 5. Schrader-Bridgeport/Standard Thomson.
 6. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.
- D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
 2. Plug End: With barbed outlet for attaching hose.

2.7 HOSE ASSEMBLIES

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless

otherwise indicated.

1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
1. Notify Owner not less than two days in advance of proposed interruption of compressed-air service.
 2. Do not proceed with interruption of compressed-air service without Owner's written permission.

3.2 PIPING APPLICATIONS

- A. Compressed-Air Piping between Air Compressors and pressure reducing valves: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Steel pipe; black, threaded, malleable-iron fittings; and threaded joints.
 2. NPS 2 and Smaller: Type L, copper tube; wrought-copper fittings; and brazed joints.
- B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Steel pipe; black, threaded, malleable-iron fittings; and threaded joints.
 2. NPS 2 and Smaller: Type L, copper tube; wrought-copper fittings; and soldered joints.
- C. Drain Piping: Use the following piping materials:
1. NPS 2 and Smaller: Type L copper tube; wrought-copper fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Comply with requirements in "Valve Applications" Article in Division 22 Section "General Duty Valves for Plumbing Piping."
- B. Equipment Isolation Valves: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.4 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were the basis to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved.
- 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 otherwise indicated.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and machines to allow service and maintenance.
- G. Install air and drain piping with 1 percent slope downward in direction of flow.
- H. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- I. Equipment and Specialty Flanged Connections:
 - 1. Use steel companion flange with gasket for connection to steel pipe.
 - 2. Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.
- J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install thermometer and pressure gage on discharge piping from each air compressor receiver. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- P. Install unions, adjacent to each valve and at final connection to each piece of equipment and machine.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from pipe and fittings before assembly.

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- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Apply appropriate tape or thread compound to external pipe threads.
- E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- G. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.6 VALVE INSTALLATION

- A. Refer to Division 22 Section "Common work Results for Plumbing" for basic piping and valve installation.
- B. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."
- C. Install shutoff valves and unions or flanged joints at compressed air piping to air compressors.
- D. Install shutoff valve at inlet to each automatic drain valve.
- E. Install shutoff valve at inlet of pressure regulator and other specialties assembly at point of use.

3.7 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric unions in piping at connections of dissimilar metal piping and tubing.

3.8 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.9 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install safety valves recommended by specialty manufacturers.
- C. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- D. Install air-line pressure regulators in branch piping to equipment.
- E. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor sink or drain.
- F. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.

- G. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filter.
- H. Install quick couplings at piping terminals for hose connections.
- I. Install hose assemblies at hose connections as directed (not all get hoses).

3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches of each fitting and coupling.
- G. Rod diameter may be reduced by one size for double-rod hangers, with 3/8-inch minimum rods.
- H. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
 - 2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 3. NPS 1-1/2: 12 feet with 3/8-inch rod.
 - 4. NPS 2: 13 feet with 3/8-inch rod.
- I. Install supports for vertical, Schedule 40, steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.
 - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
 - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
 - 7. NPS 2: 11 feet with 3/8-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.

3.11 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and

specialties. Comply with requirements in Division 22 Section " Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test pressure source and let stand for two hours to equalize temperature.
2. Repair leaks and retest until no leaks exist.
3. Inspect equipment and accessories for proper operation.
4. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
5. Report results in writing.

END OF SECTION

SECTION 22 15 19

PACKAGED AIR COMPRESSORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lubricated, reciprocating air compressors.
 - 2. Oil-flooded, rotary-screw air compressors.
 - 3. Receiver tanks.
 - 4. Particulate air filters.
 - 5. Air-cooled, compressed-air after-coolers.
 - 6. Refrigerant compressed-air dryers.
 - 7. Coalescing air filters.
 - 8. Automatic drain valves.

1.2 PERFORMANCE REQUIREMENTS

- A. The performance of the air compressor shall be third party verified by the Compressed Air and Gas Institute (CAGI) with data sheets published by CAGI.
- B. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 (i.e., the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event).

1.3 SUBMITTALS

- A. Product Data: For each model indicated, provided dimensions, weights, capacities at scheduled conditions, electrical requirements, required clearances, methods for assembling components, accessories, and location and size of each field connection.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device or variable speed drive.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to sequence lead-lag compressors for multiplex air compressors.
 - 7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Pressure Rating: At least as high as highest discharge pressure of connected compressors and bearing appropriate code symbols.
 - 2. Interior Finish: Corrosion-resistant coating.
 - 3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
- D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.2 LUBRICATED, RECIPROCATING AIR COMPRESSORS

- A. Basis of Design: The air compressor shall be an Ingersoll Rand Model 2475N5 or approved equivalent by Ingersoll Rand, Quincy, or Gardner Denver.

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- B. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
 - 1. Cast iron construction.
 - 2. Positive displacement gear-type oil pump.
 - 3. Oil filter.
 - 4. Low lubrication-oil pressure switch.
 - 5. Belt guard totally enclosing pulleys and belts.
 - 6. Automatic drain valve.
 - 7. Coalescing filter.
 - 8. Air inlet filters.
 - 9. Automatic cut/in and cut/out control.
 - 10. High ambient temperature operation.
 - 11. Base plate or legs with mounting holes.
 - 12. Air cooled after cooler.

2.3 OIL-FLOODED, ROTARY-SCREW AIR COMPRESSORS

- A. Basis of Design: The air compressor shall be an Ingersoll Rand Model RS18IE or approved equivalent by Ingersoll Rand, Quincy, or Sullair.
- B. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.
 - 1. Coupling: Non-lubricated, flexible type.
 - 2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package pre-piped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 3. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
 - 4. Air/Coolant Receiver and Separation System: 150-psig- rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 percent of maximum pressure. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
 - 6. Steel enclosure with hinged access doors and sound-attenuating material lining.
 - 7. Automatic drain valve
 - 8. Coalescing filter
 - 9. Automatic cut/in and cut/out control.
 - 10. High ambient temperature operation.
 - 11. Low ambient temperature operation.
 - 12. Base plate or legs with mounting holes.

2.4 AIR-COOLED, COMPRESSED-AIR AFTERCOOLERS (NON-INTEGRAL TO UNIT)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air/Tak, Inc.
 - 2. Gardner Denver, Inc.
 - 3. Hankison International.
 - 4. Ingersoll-Rand; Air Solutions Group.
- B. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig and leak tested at 350-psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10F above summertime maximum ambient temperature. Include moisture separator and automatic drain.

2.5 REFRIGERANT COMPRESSED-AIR DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kaiser
 - 2. Great Lakes
 - 3. Hankison International.
 - 4. Ingersoll-Rand; Air Solutions Group.
 - 5. Wilkerson Operations; Pneumatic Division.
- B. Description: Cycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35F, 100psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

2.6 COALESCING FILTERS

- A. Coalescing compressed air filter, 250 psig, 150F temperature, 0.01 micron filtration, flow rate to exceed that of flow in pipe, Speedaire Model #4ZL20 or approved equal.

2.7 PARTICULATE FILTERS

- A. Compressed air particulate filter, 0.1 micron, 290 psig, 175F temperature, flow rate to exceed that of flow in pipe, Speedaire Model #4GNU2 or approved equal.

2.8 AUTOMATIC DRAIN VALVES

- A. Automatic drain valve, electric, time on setting, time off setting, 120v power cord and plug. Speedaire Model 6Z948B or approved equal.

2.9 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Install units, level, plumb, and anchored to structure in locations indicated. Maintain manufacturer's recommended clearances. Orient equipment so controls and devices are accessible for servicing.
- B. Equipment Mounting: Install equipment on concrete bases in accordance with the manufacturer's published instructions.
- C. Install the following devices on compressed-air equipment:
 - 1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 - 2. Pressure Regulators: Install downstream from air compressors or dryers, whichever is the last item downstream.
 - 3. Automatic Drain Valves: Install on after-coolers, receivers, and dryers. Discharge condensate over nearest floor drain.
- D. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check for lubricating oil in lubricated-type equipment.
 - 3. Check belt drives for proper tension.
 - 4. Verify that air-compressor inlet filters and piping are clear.
 - 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 - 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure but not higher than rating of system components.
 - 7. Drain receiver tanks.
 - 8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 9. Test and adjust controls and safeties.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service. Flexible pipe connectors and their installation are specified in Division 22 Section "General-Service Compressed-Air Piping."
- D. Ground equipment according to Division 26.
- E. Connect wiring according to Division 26.

3.3 IDENTIFICATION

- A. Identify general-service air compressors and components. Comply with requirements for identification specified in Division 22 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 DEMONSTRATION

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

END OF SECTION

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial, heavy duty, electric, storage, domestic-water heaters.
 - 2. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 3. Thermostat-control, electric, tankless, domestic-water heaters.
 - 4. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.6 COORDINATION

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-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 Periods: From date of Substantial Completion.
 - a. Commercial, heavy duty, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: 2 years.
 - b. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.
 - c. Electric, Tankless, Domestic-Water Heaters: Two] year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. The term "withstand" means "the unit will remain in place without separation of parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Heavy Duty, Electric, Storage, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters – Heavy Duty Series
 - b. Ruud – Heavy Duty Series
 - c. A. O. Smith, Water Products Co. – Gold Series
 - d. State Water Heaters – Heavy Duty Series
 - 2. Standard: UL 1453.
 - 3. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

ELECTRIC DOMESTIC WATER HEATERS

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- 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig
 - c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 5. Special Requirements: NSF 5 construction.
- B. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters – Standard Duty Series
 - b. A. O. Smith Water Products Co. – DuraPower Series
 - c. Ruud – Light Duty Series
 - d. State Water Heaters – Light Duty Series
 2. Standard: UL 174.
 3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.

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- h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - 5. Special Requirements: NSF 5 construction with legs for off-floor installation.
- C. Capacity and Characteristics:
- 1. Refer to Plans for Capacity and Characteristics

2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:
- 1. Manufacturers: Subject to compliance with requirements, provide products specified on drawings or as manufactured by one of the following
 - a. Eemax
 - b. Instant Flow
 - c. Powerstream-Pro
 - d. Hot Aqua
 - 2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
 - 3. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
 - 4. Support: Bracket for wall mounting.

2.4 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
- 1. 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.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.

- B. Drain Pan: ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include shutoff valves per Section 22 05 23 "General-Duty Valves for Plumbing" to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
 - 1. Comply with requirements for shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing."
 - 2. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.
- M. Circulating Pumps: Lead free bronze body, Noryl impeller, ceramic shaft, double-sintered carbon bearings, 150 psi working pressure, 230F working temperature, flanged connections, 120V/1p, 92 watts, typically Bell & Gossett Model NBF-22-103252LF or approved equal. Large systems may require a pump with more capacity.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to structure.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to structure.

- C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- G. Install thermometers on tank outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23 "General-Duty Valves for Plumbing."
- I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill electric, domestic-water heaters with water.
- K. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories, showers, and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture support.
 - 6. Disposers.
 - 7. Water closets.
 - 8. Urinals.
 - 9. Lavatories.
 - 10. Individual showers.
 - 11. Service sinks.
- B. Related Sections include the following:
 - 1. Division 22 Section 22 11 16 "Domestic Water Piping."
 - 2. Division 22 Section 22 13 19 "Sanitary Waste Piping Specialties."
- C. See drawings for "Plumbing Fixture Specification."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixtures that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 ACTION SUBMITTALS

- A. Product Data: For each product indicated, include trim, fittings, accessories, appurtenances, supports, materials and finishes, dimensions, construction details, and flow rates.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Owner, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about 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. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Plastic Sinks: ANSI Z124.6.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 8. Vitreous-China Fixtures: ASME A112.19.2M.
 - 9. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 10. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucet Hose: ASTM D 3901.
 5. Faucets: ASME A112.18.1.
 6. Hose-Connection Vacuum Breakers: ASSE 1011.
 7. Hose-Coupling Threads: ASME B1.20.7.
 8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 10. NSF Materials: NSF 61.
 11. Pipe Threads: ASME B1.20.1.
 12. Supply Fittings: ASME A112.18.1.
 13. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- 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 A112.18.1M.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 5. Tubular Brass Drainage Fittings and Piping: 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. Grab Bars: ASTM F 446.
 3. Hose-Coupling Threads: ASME B1.20.7.

4. Hot-Water Dispensers: ASSE 1023 and UL 499.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Shower Receptors: ANSI Z124.2.
8. Plastic Toilet Seats: ANSI Z124.5.
9. Supply and Drain Protective Shielding Guards: ICC A117.1, ASTM D 635, ASTM C 177, ASTM G-21, ASTM G-22.

PART 2 - PRODUCTS

2.1 FIXTURES AND ASSOCIATED ACCESSORIES

- A. Provide the product indicated on the Drawings as the basis of design or approved comparable product based on the list below:
- B. Water Closet: Wall mounted, white vitreous china, elongated bowl, siphon jet bowl with 2-1/8" fully glazed trap-way, 1.6gpf consumption, ASME A112.19.2 compliant. Kohler Model K-4325 or approved equivalent from Kohler, Toto, or Sloan.
 1. Flush Valve: Manual flush valve, chrome-plated semi-red brass, 1" angle stop with vandal resistant cap, 1.6gpf, ADA flush non-hold open handle, ANSI/ASME 112.19.2 compliant. Sloan Royal Model 111-1.6 (only).
 2. Seat: Solid plastic elongated seat without cover, heavy duty, white, open front seat with stainless steel check hinge, IAPMO/ANSI Z124.5 compliant. Kohler Model K-4731-C or approved equivalent from water closet manufacturer, Bemis, or Church.
 3. Carrier: Extra heavy duty, 500-pound minimum weight rating. J. R. Smith Model 0211Y or approved equivalent from J. R. Smith, Zurn, or Watts.
- C. Water Closet: Floor mounted, two-piece, white vitreous china, elongated bowl, fully glazed trap-way, 1.6gpf, ASME A112.19.2 compliant. Kohler Model K-3978 or approved equivalent from Kohler, Toto, or Sloan.
 1. Seat: Solid plastic elongated seat without cover, heavy duty, white, open front seat with stainless steel check hinge, IAPMO/ANSI Z124.5 compliant. Kohler Model K-4731-C or approved equivalent from water closet manufacturer, Bemis, or Church.
 2. Supply: Quarter turn angle stop with handle, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers
- D. Urinal: Wall mounted, vitreous china, wash-out urinal with flushing rim and trap, 3/4" top spud, 2" female outlet flange, two (2) wall hangers, 1.0gpf, ADA compliant. Kohler Model K-4991 ET or approved equivalent from Kohler, Toto, or Sloan.
 1. Flush Valve: Battery powered, sensor operated urinal flush valve, chrome-plated semi-red brass body 1.0gpf, 3/4" angle stop, vacuum breaker, ANSI/ASME 112.19.2 compliant. Sloan Model Optima Royal 186 SMOOTH-1.0 with EBV-89A-M battery control (only).
 2. Carrier: Floor mounted urinal carrier with heavy gauge steel offset uprights with welded feet, universal steel hanger support plate and bottom bearing plate with

integral mounting brackets, and plated hardware. J.R. Smith Model 0615 or approved equivalent from J. R. Smith, Zurn, or Watts.

- E. Lavatory (under-mount): Vitreous china lavatory, under mounted, grid drain, glazed underside. ADA, ANSI A117.1, ASME A112.19.2M. Kohler Model No. K-2211-G or approved equivalent from Kohler or Sloan.
1. Faucet: Gooseneck faucet, Eco powered, 10 second continuous flow, single hole center set, self-adjusting infrared sensor, factory controller, polished chrome solid brass body, 0.5 gpm aerator, vandal resistant. Toto Model T24T51E#CP (only).
 2. Supplies: Quarter turn angle stops with handles, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 3. Drain/Trap: 1-1/4" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, box escutcheon, insulating kit. McGuire Model No. MCT125085B or approved equivalent from McGuire, Kohler, or Zurn. Pre-wrapped trap and drain assemblies are also acceptable.
 4. TMV: Thermostatic mixing valve, lead free brass body, stainless steel spring, copper thermostat, Buna-N seals, 0.25 gpm to 2.25 gpm, Watts Model LFUSG-B.
- F. Lavatory (wall mounted): Kohler Model No. K-2084, 20"x18", vitreous china, wall mounted, grid drain, glazed underside. ADA, ANSI A117.1, ASME A112.19.2M, soap dish on right side.
1. Faucet: Gooseneck faucet, Eco powered, 10 second continuous flow, single hole center set, self-adjusting infrared sensor, factory controller, polished chrome solid brass body, 0.5 gpm aerator, vandal resistant. Toto Model T24T51E#CP (only).
 2. Supplies: Quarter turn angle stops with handles, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 3. Drain/Trap: 1-1/4" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, box escutcheon insulating kit. McGuire Model No. MCT125085B or approved equivalent from McGuire, Kohler, or Zurn. Pre-wrapped trap and drain assemblies are also acceptable.
 4. TMV: Thermostatic mixing valve, lead free brass body, stainless steel spring, copper thermostat, Buna-N seals, 0.25 gpm to 2.25 gpm, Watts Model LFUSG-B.
- G. Shower: Shower and hand shower system, showerhead and bracket, wall/hand shower, polished chrome, integral service stops, ADA compliant, pressure-balancing mixing valve, dual outlet diverter with handle and trim. Symmons ELM Model 5505 or approved equivalent from Symmons, Kohler, or Delta.
1. Shower Drain: Sioux Chief Series 822 PVC drain, 2" drain, with fully adjustable square top, color to match faucet accessory. Provide with SureSeal Trap Guard seal in p-trap to match trap size.
- H. Wash Fountain: Wash fountain, shallow bowl, multi-user, off-line vent, supplies through wall, infrared sensor activation, 24vac transformer, standard height, backsplash,. Bradley "Sentry" Model or approved equivalent from Bradley, Acorn, or Willoughby.

1. Supply: Quarter turn angle stop with handles, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers
 2. Drain/Trap: 1-1/4" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, box escutcheon, McGuire Model No. MCT125085B or approved equivalent from McGuire, Kohler, or Zurn.
 3. Wall guard: custom built, two 48"x96" wall panels mounted on wall, with safety edge trim, 316 stainless steel, 18 gauge, pre-drilled screw holes on edges with 16" centers, stainless steel wall anchors. Provide pre-drilled holes for pipe penetrations. Provide pre-drilled holes for attachment of basin and associated toilet room accessories to wall structure.
 4. TMV: Thermostatic mixing valve, lead free brass body, stainless steel spring, copper thermostat, Buna-N seals, 0.25 gpm to 2.25 gpm, Watts Model LFUSG-B.
- I. Sink (ADA, Break Room): Undermount sink, double compartment, type 304, 18 gauge stainless steel NLT 5" depth undercoated. Kohler Model No. K-3996-4 or approved equivalent from Kohler, Elkay, or Moen.
1. Faucet: Polished chrome color, ceramic disk valve, 1.5 gpm aerator, swing spout with pullout spray handle, ADA, NSF-61, ASME A112.18.1 compliant. Delta 4353-DST or approved equivalent from Kohler, Delta, or Moen.
 2. Supply: Quarter turn angle stops with handles, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 3. Drain/Trap: 1-1/2" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, box escutcheon insulating kit. McGuire Model No. MCT125090B or approved equivalent from McGuire, Kohler, or Zurn.
 4. Disposer: Insinkerator Evolution Compact Model with Multigrind and Soundseal Technologies, 3/4 hp with overload protection, 120 volt/ 1 phase, 8.1 amps., continuous-feed, reset button, corrosion-resistant chamber with jam-resistant, stainless steel grinder or shredder, nps 1-1/2" outlet, quick-mounting, stainless steel sink flange, antisplash guard, disposal tee drainage fitting, and combination cover/stopper.
- J. Sink (ADA, Mother's Room): Undermount sink, single bowl, type 304, 18 gauge stainless steel, sound deadening on sides and bottom, rear center drain placement. Kohler Model K-3331 or approved equivalent from Kohler, Elkay, or Moen.
1. Faucet: Polished chrome color, ceramic disk valves, 1.8 gpm aerator, wrist blade handles, rigid gooseneck, ADA, NSF-61, ANSI A117.1, ASME A112.18.1 compliant. Kohler Model No. K-16112-4 or approved equivalent from Kohler, Delta, or Moen.
 2. Supply: Quarter turn angle stops with handles, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 3. Drain/Trap: 1-1/2" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, box escutcheon insulating kit. McGuire Model No. MCT125090B or approved equivalent from McGuire, Kohler, or Zurn.

- K. Mop Sink: Molded stone, mop service basin, 24"x24"x10". Fiat Model MSG 2424 10" high back splash, 1453-BB 3" stainless steel drain. Fiat Model No. MSBIDTG2424 or approved equivalent from Fiat, Acorn, or Zurn
 - 1. Faucet: Wall mounted faucet, quarter turn cartridge, vacuum breaker, integral stops, fixed spout with bucket hook, 3/4" hose thread, support rod. Chicago #445-VBRRCF or approved equivalent from Kohler, Chicago, or Speakman.
 - 2. Accessories: hose and hose bracket, Fiat Model No. 889CC mop bucket, 889CC mop hanger.
 - 3. Wall guard: custom built corner installation, two 48"x96" wall panels mounted on wall, with safety edge trim, 316 stainless steel, 18 gauge, pre-drilled screw holes on edges with 16" centers, stainless steel wall anchors. mount mop hanger to wall panel. provide pre-drilled holes to mount supply fitting. seal corners, mop sink, and mounting hardware watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the water supply, drainage, and vent piping rough-in to verify their actual locations are compatible with the proper installation of the carriers and fixtures.
- B. Examine the walls, partitions, and floors to verify suitable conditions exist for the installation of the carriers and fixtures.
- C. Proceed with the installation of fixtures only after proper conditions for installations are present. Coordinate any required adjustments with the other contractors, as necessary.
- D. Collaborate with the framing contractor so no studs or other framing members are notched, hole sawed, or cut for the installation of the plumbing.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports affixed to building structure for wall-hanging 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 back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.

- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install stop valve with handle on each supply line to each fixture to be connected to water distribution piping. Attach supplies in a rigid manner to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- J. Install chrome plated brass trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install chrome plated tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible compliant water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, compliant tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns aerator in faucet spouts if faucets are not furnished with required rates and patterns.
- P. Install shower head with flow-control with specified maximum flow rates.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect waste piping.
- R. Install disposer in outlet of sinks indicated to have disposer. Install operating switch where it indicated or in wall adjacent to sink if location is not indicated.
- S. Install escutcheons at piping for wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.
- T. Set bathtubs, shower receptors, and service basins in leveling bed of cement grout. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.
- U. Provide pre-insulated drains, off-set drains, p-traps, and drainpipe exposed for accessible compliant lavatories and sinks.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- C. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- D. Ground equipment according to Division 26.
- E. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

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

3.5 PROTECTION

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

END OF SECTION

SECTION 22 45 00

EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Emergency showers.
 - 2. Eyewash equipment.
 - 3. Eye/face wash equipment.
 - 4. Combination units.
 - 5. Water-tempering equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

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PART 2 - PRODUCTS

2.1 EMERGENCY SHOWERS

A. Freestanding, Plumbed Emergency Showers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Haws Corporation.
2. Capacity: Not less than 20 gpm for at least 15 minutes.
3. Supply Piping: NPS 1galvanized steel or PVC with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Pull rod or Foot treadle.
5. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel
6. Mounting: Pedestal.

2.2 EYEWASH EQUIPMENT

A. Standard, Freestanding, Plumbed Eyewash Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Haws Corporation.
2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle or Treadle.
5. Spray-Head Assembly: Two receptor-mounted spray heads.
6. Receptor: Chrome-plated brass or stainless-steel bowl.
7. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2 Include galvanized-steel indirect connection to drainage system.
8. Mounting: Pedestal.

B. Accessible, Freestanding, Plumbed Eyewash Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.

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- c. Haws Corporation.
- 2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
- 3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
- 4. Control-Valve Actuator: Paddle.
- 5. Spray-Head Assembly: Two receptor-mounted spray heads.
- 6. Receptor: Chrome-plated brass or stainless-steel bowl.
- 7. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2 Include galvanized-steel indirect connection to drainage system.
- 8. Mounting: Offset pedestal.
- 9. Special Construction: Comply with ICC/ANSI A117.1.

2.3 EYE/FACE WASH EQUIPMENT

A. Standard, Freestanding, Plumbed, Eye/Face Wash Units:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Haws Corporation.
- 2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
- 3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
- 4. Control-Valve Actuator: Paddle or Treadle.
- 5. 5. Spray-Head Assembly: Two or four receptor-mounted spray heads.
- 6. 6. Receptor: Chrome-plated brass or stainless-steel bowl.
- 7. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2 Include galvanized-steel indirect connection to drainage system.
- 8. Mounting: Pedestal.

B. Accessible, Freestanding, Plumbed, Eye/Face Wash Units:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. WaterSaver Faucet Co.
- 2. Capacity: Not less than 3 gpm for at least 15 minutes.

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3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two or four receptor-mounted spray heads.
6. Receptor: Chrome-plated brass or stainless-steel bowl.
7. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2 Include galvanized-steel indirect connection to drainage system.
8. Mounting: Offset pedestal.
9. Special Construction: Comply with ICC/ANSI A117.1.

2.4 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eyewash Combination Unit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Sellstrom Manufacturing Company.
 - g. Speakman Company.
 - h. WaterSaver Faucet Co.
2. Piping:
 - a. Material: Galvanized steel, Chrome-plated brass or PVC.
 - b. Unit Supply: NPS 1-1/4 minimum.
 - c. Unit Drain: Outlet at back or side near bottom.
3. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod or Treadle.
 - d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.
 - e. Mounting: Pedestal.
4. Eyewash Unit:
 - a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Spray-Head Assembly: Two receptor-mounted spray heads.

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- e. Receptor: Chrome-plated brass or stainless-steel bowl.
 - f. Mounting: Attached shower pedestal.
 - g. Drench-Hose Option: May be provided instead of eyewash unit.
 - 1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - 2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
 - 3) Mounting: Bracket on shower pedestal.
- B. Standard, Plumbed Emergency Shower with Eye/Face Wash Combination Units:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Sellstrom Manufacturing Company.
 - g. Speakman Company.
 - h. WaterSaver Faucet Co.
 - 2. Piping:
 - a. Material: Galvanized steel, Chrome-plated brass, stainless steel or PVC.
 - b. Unit Supply: NPS 1-1/4 minimum
 - c. Unit Drain: Outlet at back or side near bottom.
 - 3. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod or Treadle.
 - d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.
 - e. Mounting: Pedestal.
 - 4. Eye/Face Wash Unit:
 - a. Capacity: Not less than 3 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
 - e. Receptor: Chrome-plated brass or stainless-steel bowl.
 - f. Mounting: Attached shower pedestal.
 - g. Drench-Hose Option: May be provided instead of eye/face wash unit.
 - 1) Capacity: Not less than 3 gpm for at least 15 minutes.
 - 2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.

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- 3) Mounting: Bracket on shower pedestal.

2.5 WATER-TEMPERING EQUIPMENT

- A. Hot- and Cold-Water, Water-Tempering Equipment:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Sellstrom Manufacturing Company.
 - g. Speakman Company.
 - h. WaterSaver Faucet Co.
 2. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F 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.
 - b. Supply Connections: For hot and cold water.

2.6 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Insulate outdoor fixtures and plumbing to prevent water from solar heating to an uncomfortable or dangerous level. Install outdoor fixtures under shade when possible.
- B. Install fixtures level and plumb and fasten to substrate.
- C. Install shutoff valves in water-supply piping to fixtures. Install valves chained in open position. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 05 23 "General-Duty Valves for Plumbing."

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- D. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."
- E. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- F. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system.
- G. Fill self-contained fixtures with flushing fluid.

3.2 CONNECTIONS

- A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 11 16 "Domestic Water Piping."
- B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.3 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform visual and mechanical inspection.
 - 2. Perform Leak Test after installation and charging.
 - 3. Perform Operational Test after electrical circuitry has been energized to test safety features.
 - 4. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.

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Project Name
Project Number

Deliverable
Issue Date

- B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 47 16

WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wall mounted water coolers, indoor locations.
 - 2. In-wall mounted water coolers, indoor locations.
 - 3. Wall mounted water coolers, outdoor locations.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include trim, fittings, accessories, appurtenances, supports, materials and finishes, dimensions, construction details, and flow rates.
- B. Operation and maintenance data.
- C. Documentation of 5-year warranty on refrigeration system.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Owner, and marked for intended use; including UL 399 Standard for Drinking-Water Coolers.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Compliance with ASME 112.19.3 Standard for Stainless Steel Plumbing Fixtures.

PART 2 - PRODUCTS

2.1 WATER COOLERS AND ASSOCIATED ACCESSORIES

- A. Basis-of-Design Products: Provide the product indicated on the Drawings or approved comparable product based on the list below:
1. Water Cooler (Wall Mounted): Electric refrigerated water cooler, stainless steel finish, two bi-level station bubblers with push button activation, flexible polyester elastomer bubblers, laminar flow bottle filling station with electronic sensor activation, ADA compliant, 8 gph of 50F water with 80F room temperature, R134a refrigerant, hermetically sealed compressor, fan cooled condenser with copper tubes and aluminum fins, certified lead free design, factory carrier, and 115/1/60 power requirement. Elkay LZSTL8WSSP or approved equivalent from Elkay, Halsey Taylor, or Murdock.
 - a. Filtration: Elkay WaterSentry Plus Filtration Assembly, 1.5 gpm flow rate, 3,000-gallon capacity per cartridge, NSF Certified to NSF/ANSI 42 & 53 for reduction of chlorine, taste and odor, Particulate Class 1, and lead.
 - b. Supply: Quarter turn angle stop, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 - c. Drain/Trap: 1-1/2" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, insulating kit. McGuire Model No. MCT150090B or approved equivalent from McGuire, Kohler, or Zurn.
 2. Water Cooler (Wall Mounted)(Outdoor Locations): Electric refrigerated water cooler, stainless steel finish, single level station bubbler with push button activation, flexible polyester elastomer bubbler, laminar flow bottle filling station with electronic button activation, vandal resistant, 8 gph of 50F water with 80F ambient temperature, R134a refrigerant, hermetically sealed compressor, fan cooled condenser with copper tubes and aluminum fins, certified lead free design, factory carrier, and 115/1/60 power requirement. Elkay VRC8WSK or approved equivalent from Elkay, Halsey Taylor, or Murdock.
 - a. Supply: Quarter turn angle stop, 1/2" x 3/8", stainless steel braided risers. McGuire Model LFBV2-02 or approved equivalent from McGuire, Brass Craft, or Dahl Brothers.
 - b. Drain/Trap: 1-1/2" cast brass p-trap with brass nuts, 17 gage, cleanout, flange, insulating kit. McGuire Model No. MCT150090B or approved equivalent from McGuire, Kohler, or Zurn.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the water supply, drainage, and vent piping rough-in to verify their actual locations are compatible with the proper installation of the carriers and fixtures.

- B. Examine the walls, partitions, and floors to verify suitable conditions exist for the installation of the carriers and fixtures.
- C. Proceed with the installation of fixtures only after proper conditions for installations are present. Coordinate required adjustments with the other contractors, as necessary.
- D. Collaborate with the framing contractor so no studs or other framing members are notched, hole-sawed, or cut for the installation of the plumbing.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.3 INSTALLATION

- A. The fixture installation shall be in accordance with the manufacturer's published instructions.
- B. Provide off-floor supports affixed to building structure and attach wall-mounting fixtures, unless otherwise indicated.
- C. Provide fixtures level and plumb. For fixtures indicated for children, install at height indicated on Drawings.
- D. Provide water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section 22 05 23 "General-Duty Valves for Plumbing."
- E. Provide trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Provide pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section 22 05 15 "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07.

3.4 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.

- B. Ground equipment according to Division 26.
- C. Connect wiring according to Division 26.

3.5 FIELD QUALITY CONTROL

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

3.6 ADJUSTING

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

END OF SECTION