PART 1 - GENERAL

1.1 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and codes and standards in addition to those listed elsewhere in the contract documents are hereby imposed on a general basis for plumbing work.

1.2 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable plumbing systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.3 RELATED DOCUMENTS AND OTHER INFORMATION:

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the portions of work specified in each and every Section of this Division, individually and collectively.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Contractor shall provide no less than 14 days notice to owner when scheduling outages. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

1.5 PRODUCT WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceeds the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 14 days prior to opening of bids. Refer to the general conditions for the substitution request.
form and required documentation.

PART 2 - NOT USED.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 220000
SECTION 22 05 10 - PLUMBING COORDINATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Retain or delete this article in all Sections of Project Manual.

B. Plumbing Coordination Drawings: Prepare a set of coordination drawings showing the coordination of the major elements, components, and systems of the Plumbing work, and showing the coordination of Plumbing work with other work. Prepare drawings at accurate scale and sufficiently large to show locations of every item, including clearances for installing, maintaining, insulating, breaking down equipment, replacing motors and similar requirements. Drawings shall indicate coordination with all other trades including, but not limited to, lighting, structural, plumbing, and architectural items. Prepare drawings to include plans, elevations, sections and details as needed to conclusively show successful coordination and integration of the work. Submit drawings for review by the Architect/Engineer and Owner.
1. Plans shall include dimensioned locations of all Floor Drains
2. Plans shall include locations of all ceiling and wall access panels required for equipment access (valves, for example).

C. Record Drawings: During construction operations, the Plumbing contractor shall faithfully make a record of all approved changes from the contract drawings, including accurate dimensions where applicable, and shall also record accurate dimensions locating all below-grade outside Plumbing utilities (whether changed or not) with reference to permanent above-grade objects. A minimum of two (2) dimensions from building reference points shall be provided and a bury depth indicated. At completion of the work, all such changes shall be recorded neatly with red ink by the Plumbing contractor on an unused set of the Plumbing contract drawings supplied by the architect.

D. Photographs: For all below-grade plumbing piping, photograph installation of trenches before backfilling. Submit to A/E for review and include in closeout documents to the Owner.

1.2 RELATED DOCUMENTS AND OTHER INFORMATION:

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the portions of work specified in each and every Section of this Division, individually and collectively.

PART 2 - PRODUCTS

1.1 PLUMBING PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of Plumbing equipment. The electrical design was based on the power requirements of the Plumbing equipment manufacturer scheduled or specified as "basis of design." Any modifications to the electrical system that are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. Refer to Division 26 specifications for additional coordination requirements.
B. Coordination of Options and Substitutions: When the contract documents permit the selection from several product options and it becomes necessary to authorize a substitution, do not proceed with purchase until coordination of interface to equipment has been checked and satisfactorily established.

PART 3 - EXECUTION

1.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the Plumbing work must examine the condition of the substrate to receive the work, the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until Plumbing coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

1.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is no other reasonable method for completing the Plumbing work, and where the proposed cutting clearly does not materially weaken the structure.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate Plumbing work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of Plumbing work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:
   1. Exposed concrete finishes.
   2. Exposed masonry.
   3. Waterproofing and vapor barriers.
   4. Roofing, flashing and accessories.
   5. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means

1.3 COORDINATION OF PLUMBING INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of Plumbing work so that the Plumbing system will perform as indicated and be in harmony with the other work of the building.
The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation. Conceal where possible.
2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
3. Give the right-of-way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the Plumbing work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install Plumbing equipment ready for electrical connection. Refer to the electrical sections of the specifications for electrical connection of Plumbing equipment.

D. Utility Connections: Coordinate the connection of Plumbing systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies.
   1. Provide a single connection for each service except where multiple connections are indicated. Water, tap, meter, and vault cost shall be incurred by the Contractor.

1.4 COORDINATION OF PLUMBING START-UP:

A. Seasonal Requirements: Adjust and coordinate the timing of Plumbing system start-ups with seasonal variations, so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off-season start-ups to ensure that systems and equipment will not be damaged by the operation.

END OF SECTION 200510
PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 22.

B. Definitions:
   1. Exposed: Piping and equipment exposed to view in finished rooms.
   2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

A. Section GENERAL CONDITIONS.

B. Section GENERAL REQUIREMENTS.

C. Section SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Excavation and Backfill: Section EARTH MOVING.

E. Concrete and Grout: Section CAST-IN-PLACE CONCRETE.

F. Flashing for Wall and Roof Penetrations: Section FLASHING AND SHEET METAL.

G. Section JOINT SEALANTS.

H. Section PAINTING.

I. Section PLUMBING PIPING INSULATION.

1.3 QUALITY ASSURANCE

A. Products Criteria:

   1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.

   2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming.

   3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

   4. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent then those specified. Refer any conflicts to the Architect.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Architect prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

D. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Architect for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Architect at least two weeks prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the Architect for resolution.
3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 specifications.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION COMMON WORK RESULTS FOR PLUMBING", with applicable "Group" number.

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

F. Upon request by Owner, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

G. Manufacturer’s Literature and Data: Submit under the pertinent section rather than under this section.
   1. Submit electric motor data and variable speed drive data with the driven equipment.
   2. Equipment and materials identification.
   3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
   4. Wall, floor, and ceiling plates.

H. Maintenance Data and Operating Instructions:
   1. Maintenance and operating manuals in accordance with Division 1 specifications for systems and equipment.
   2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:
   1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
   2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Architect. Such repair or replacement shall be at no additional cost to the Owner.
   3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
   4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:
   1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
   2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
   3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.
   4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. 2012 International Building Code with SC modifications
C. 2012 International Fire Code with SC modifications
D. 2012 International Plumbing Code
E. 2012 International Mechanical Code
F. 2009 International Energy Conservation Code
G. 2012 International Fuel Gas Code with SC modifications
H. 2011 National Electrical Code
I. American Society of Mechanical Engineers (ASME):
J. Boiler and Pressure Vessel Code (BPVC):
SEC IX-98 Qualifications Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
A36/A36M-08 Carbon Structural Steel
E84-09 Standard Test Method for Burning Characteristics of Building Materials
E119-08a Standard Test Method for Fire Tests of Building Construction and Materials
L. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-93 Pipe Hangers and Supports-Materials, Design and Manufacture
SP 69-2003 Pipe Hangers and Supports-Selection and Application
M. National Electrical Manufacturers Association (NEMA):
MG1-2003, Rev. 1-2004 Motors and Generators
N. National Association of Plumbing - Heating - Cooling Contractors (NAPHCC)

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.
B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 SAFETY GUARDS

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.4 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods shall conform to the requirements of GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section LOW-VOLTAGE MOTOR STARTERS; and, Section LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.

B. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Owner.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency” shall comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.6 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. Type Numbers Specified: MSS SP-58. For selection and application refer to MSS SP-69.

B. For Attachment to Concrete Construction:
   1. Concrete insert: Type 18, MSS SP-58.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than four inches thick when approved by the Architect for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than four inches thick when approved by the Architect for each job condition.

C. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.

D. For Attachment to Wood Construction: Wood screws or lag bolts.

E. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

F. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
1. Allowable hanger load: Manufacturers rating less 200 pounds.
2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

G. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

1. General Types (MSS SP-58):
   a. Standard clevis hanger: Type 1; provide locknut.
   b. Riser clamps: Type 8.
   c. Wall brackets: Types 31, 32 or 33.
   d. Roller supports: Type 41, 43, 44 and 46.
   e. Saddle support: Type 36, 37 or 38.
   f. Turnbuckle: Types 13 or 15, preinsulate
   g. U-bolt clamp: Type 24.
   h. Copper Tube:
      i. Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
      j. For vertical runs use epoxy painted or plastic coated riser clamps.
      k. For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
   l. Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
   m. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

2. Plumbing Piping (Other Than General Types):
   a. Horizontal piping: Type 1, 5, 7, 9, and 10.
   b. Chrome plated piping: Chrome plated supports.
   c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
   d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.

H. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 140 psi compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
   a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
   b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or
more of the following features: structural inserts 600 psi compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.

5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.7 PIPE PENETRATIONS

A. Install sleeves during construction for all pipe penetrations.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve one inch above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Project Engineer.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

G. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation.

H. Sealant and Adhesives: Shall be as specified in Section JOINT SEALANTS.

2.8 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Architect, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Architect.

D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.9 WALL, FLOOR AND CEILING PLATES
A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3-inch pipe, 0.035-inch for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.10 ASBESTOS

A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, and equipment, access provisions, and work of all trades. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities.

B. Follow manufacturer's published recommendations for installation methods not otherwise specified.

C. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

D. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

F. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Architect where working area space is limited.

2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Architect. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Architect for approval.

3. Do not penetrate membrane waterproofing.

G. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

I. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Architect. Damaged or defective items in the opinion of the Architect, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum, specified in Section CAST-IN-PLACE CONCRETE.

J. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

3.2 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with prior approval of the Architect.

B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 1/2-inch clearance between pipe or piping covering and adjacent work.

D. Plumbing horizontal and vertical pipe supports, refer to the NAPHCC National Standard Plumbing Code.

E. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.

2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.

3. Tubing and capillary systems shall be supported in channel troughs.

F. Floor Supports:
1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 2 inch excess on all edges. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

G. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

3.3 LUBRICATION

A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one quart of oil and one pound of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Owner in unopened containers that are properly identified as to application.

C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.

D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.4 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the building for beneficial use by the Owner, the building facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.

2. Material And Equipment Not To Be Painted Includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
j. Glass.
k. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.5 STARTUP AND TEMPORARY OPERATION
A. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

3.6 OPERATING AND PERFORMANCE TESTS
A. Prior to the final inspection, perform required tests as specified in Section GENERAL REQUIREMENTS, and submit the test reports and records to the Architect.
B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.7 OPERATION AND MAINTENANCE MANUALS
A. Provide four bound copies. Deliver to Owner not less than 30 days prior to completion of a phase or final inspection.
B. Include all new and temporary equipment and all elements of each assembly.
C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, other data.
D. Manufacturer’s installation, maintenance, repair, and operation instructions for each device. Include assembly drawings and parts lists. Include operating precautions and reasons for precautions.
E. Lubrication instructions including type and quantity of lubricant.
1. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications.
2. Set points of all interlock devices.
3. Trouble-shooting guide for control systems.
4. Operation of the any control system.
5. Emergency procedures.

END OF SECTION 220511
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES
A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 STACK-SLEEVE FITTINGS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. MIFAB, Inc.
   4. Approved equal.
B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. **Underdeck Clamp:** Clamping ring with setscrews.

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### 2.3 SLEEVE-SEAL SYSTEMS

#### A. Manufacturers:

Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT (Link-Seal).
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.
7. Or approved equal.

#### B. Description:

Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. **Sealing Elements:** EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. **Pressure Plates:** Stainless steel.
3. **Connecting Bolts and Nuts:** Stainless steel of length required to secure pressure plates to sealing elements.

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### 2.4 GROUT

#### A. Standard:


#### B. Characteristics:

Nonshrink; recommended for interior and exterior applications.

#### C. Design Mix:

5000-psi, 28-day compressive strength.

#### D. Packaging:

Premixed and factory packaged.

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**PART 3 - EXECUTION**

### 3.1 SLEEVE INSTALLATION

#### A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

#### B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

#### C. Install sleeves in concrete floors, concrete roof slabs, concrete walls, and masonry walls as new slabs and walls are constructed.
D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and
      pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate
      for size, depth, and location of joint.

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

3.2 STACK-SLEEVE-FITTING INSTALLATION
   A. Install stack-sleeve fittings in new slabs as slabs are constructed.
      1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and
         pipe or pipe insulation.
      2. Secure flashing between clamping flanges for pipes penetrating floors with membrane
         waterproofing.
      3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
      4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
      5. Using grout, seal the space around outside of stack-sleeve fittings.
   B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe
penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION
   A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping
entries into building.
   B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID
or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal
system components, and install in annular space between piping and sleeve. Tighten bolts against
pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE
   A. Use sleeves and sleeve seals for the following piping-penetration applications:
      1. Exterior Concrete Walls above Grade:
         a. Galvanized-steel wall sleeves with sleeve-seal system.
      2. Concrete Slabs-on-Grade:
         a. Galvanized-steel-pipe sleeves with sleeve-seal system.
            1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve
for installing sleeve-seal system.
3. Concrete Slabs above Grade:
   a. Galvanized-steel sleeves with sleeve-seal system.

END OF SECTION 220517
SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Liquid-in-glass thermometers.
      2. Dial-type pressure gages.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS
   A. Product Certificates: For each type of meter and gage, from manufacturer.

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

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS
   A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
      1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         a. Flo Fab Inc.
         b. Miljoco Corporation.
         d. Tel-Tru Manufacturing Company.
         e. Trerice, H. O. Co.
         f. Weiss Instruments, Inc.
g. Winters Instruments - U.S.

h. Or approved equal.

3. Case: Cast aluminum; 6-inch nominal size.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass or plastic.
7. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 PRESSURE GAGES

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

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. AMETEK, Inc.; U.S. Gauge.

b. Ashcroft Inc.

c. Ernst Flow Industries.

d. Flo Fab Inc.

e. Marsh Bellofram.

f. Miljoco Corporation.

g. Noshok.

h. Palmer Wahl Instrumentation Group.

i. REOTEMP Instrument Corporation.

j. Tel-Tru Manufacturing Company.

k. Trerice, H. O. Co.

l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

m. Weiss Instruments, Inc.

n. WIKA Instrument Corporation - USA.

o. Winters Instruments - U.S.

p. Or approved equal.

3. Case: Sealed type; cast aluminum; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.3 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
B. **Valves:** Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

**PART 3 - EXECUTION**

3.1 **INSTALLATION**

A. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

B. Install valve and snubber in piping for each pressure gage for fluids.

C. Install test plugs in piping tees.

D. Install pressure gages in the following locations:

   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

3.2 **CONNECTIONS**

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

3.3 **ADJUSTING**

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

3.4 **PRESSURE-GAGE SCHEDULE**

A. Pressure gages shall be the following:

   1. Sealed, direct-mounted, metal case.

3.5 **PRESSURE-GAGE SCALE-RANGE SCHEDULE**

A. Scale Range for Domestic Water Piping: 0 to 100 psi.

**END OF SECTION 220519**
SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Brass ball valves.
   2. Bronze ball valves.
   4. Bronze swing check valves.
   5. Iron swing check valves.

B. Related Sections:
   1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
   2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

C. NSF/ANSI Compliance: NSF 61 for valve materials for potable-water service.

D. NSF/ANSI Compliance: NSF 372 for low lead construction for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Standards: NSF/ANSI 61 & 372.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller.

F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

G. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.3 BRONZE BALL VALVES

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

1. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Description:
   a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.5 BRONZE SWING CHECK VALVES

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

1. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: PTFE.

2.6 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Description:
   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 500 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Composition.
   g. Seat Ring: Bronze.
   h. Disc Holder: Bronze.
   i. Disc: PTFE or TFE.
   j. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly valves.
   3. Throttling Service: Ball, or butterfly valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
   3. Bronze Swing Check Valves: Class 150, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:
   2. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.

END OF SECTION 220523
SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.
B. Related Sections:
   1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

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

1.4 PERFORMANCE REQUIREMENTS
A. 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 7-10.
   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.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

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

C. Engineered Seismic Submittal: For pipe and equipment hangers and supports, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. 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.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2.2 TRAPEZE PIPE HANGERS

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

A. MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   3. Channels: Continuous slotted steel channel with inturned lips.
   4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

2.4 THERMAL-HANGER SHIELD INSERTS

A. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
B. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
C. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support piping.
B. High-Type, Single-Pipe Stand:
   2. Vertical Members: Two or more stainless-steel, continuous-thread rods.
   3. Horizontal Member: Stainless-steel rod with stainless-steel, roller-type pipe support.
C. High-Type, Multiple-Pipe Stand:
   2. Vertical Members: Two or more stainless-steel channels.
   3. Horizontal Member: Stainless-steel channel.

2.7 PIPE POSITIONING SYSTEMS

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

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

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, stainless-steel plates, shapes, and bars.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, stainless-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:
   1. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      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.
   4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.
3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Use stainless-steel pipe hangers and stainless-steel attachments.

B. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

C. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.
H. 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. Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 8): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
11. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
12. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
13. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
14. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
15. 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 steel plate.
16. 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 steel plate, and with U-bolt to retain pipe.
17. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
18. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
19. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
20. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
21. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
22. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. 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.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529
SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes plumbing piping heat tracing for freeze prevention with the following electric heating cables:
      1. Self-regulating, parallel resistance.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
      2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
   B. Shop Drawings: For electric heating cable.
      1. Include plans, elevations, sections, and attachment details.
      2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.
   B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chromalox.
2. Nelson Heat Trace
3. Raychem
4. Thermon Americas Inc.
5. Or approved equal.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.

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

G. Capacities and Characteristics:

2. Piping Diameter: See drawings.
3. Number of Parallel Cables: 2.
4. Electrical Characteristics for Single-Circuit Connection:
   a. Volts: 120.

2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. A bimetallic pipewall sensing thermostat preset at 40°F with a switch rating of 22 amps at 120 VAC based on current loads for each circuit.
2. Corrosion-resistant, waterproof control enclosure.
2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.


PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:
1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
2. Test cables for electrical continuity and insulation integrity before energizing.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

D. Cables will be considered defective if they do not pass tests and inspections.

E. Prepare test reports.

3.4 PROTECTION

A. Protect installed heating cables, including nonheating leads, from damage during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533
SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit signed and sealed shop drawings from a professional engineer. Shop drawings to include project specific details, sketches, product data cut sheets.

B. See drawings for additional requirements.

PART 2 - NOT USED.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Refer to the details and notes on the construction documents.

3.2 FIELD QUALITY CONTROL

A. Inspect installation after installation and submit report.

END OF SECTION 220548
SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve tags.
   4. Warning tags.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
D. Valve numbering scheme.
E. Valve Schedules: For each piping system to include in maintenance manuals.

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
A. Metal Labels for Equipment:
1. **Material and Thickness:** Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. **Minimum Letter Size:** 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. **Fasteners:** Stainless-steel rivets or self-tapping screws.

5. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.

**B. Label Content:** Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

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

### 2.2 PIPE LABELS

**A. General Requirements for Manufactured Pipe Labels:** Preprinted, color-coded, with lettering indicating service, and showing flow direction.

**B. Pretensioned Pipe Labels:** Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

**C. Self-Adhesive Pipe Labels:** Printed plastic with contact-type, permanent-adhesive backing.

**D. Pipe Label Contents:** Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. **Flow-Direction Arrows:** Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. **Lettering Size:** At least 1-1/2 inches high.

### 2.3 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:** Stainless Steel, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. **Fasteners:** Brass beaded chain.

**B. Valve Schedules:** For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. **Valve-tag schedule shall be included in operation and maintenance data.**
PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. 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 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: Blue.

2. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Black or Green.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

END OF SECTION 220553
SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Piping insulation for domestic hot, tempered, and cold water piping.
2. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. 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.
   d. Or approved equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 BLV Adhesive.
   d. K-Flex USA; R-373 Contact Adhesive.
   e. Or approved equal.

2. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2.3 SEALANTS

A. Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. Sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

   a. Finish and thickness are indicated in field-applied jacket schedules.
   b. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.
   c. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot/tempered- and cold-
water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA)
requirements.

PART 3 - EXECUTION

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

3.2 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely
affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion
coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy
finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult
coating manufacturer for appropriate coating materials and application methods for operating
temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with
an epoxy coating. Consult coating manufacturer for appropriate coating materials and application
methods for operating temperature range.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-
steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of
voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each
item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories
that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
3.4 PENETRATIONS

A. Insulation Installation at Underground Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Aboveground 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.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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. Finish exposed surfaces with a metal jacket.

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 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 2 inches thick.

3.12 FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. Painted Aluminum, 0.016 inch thick.

END OF SECTION 220719
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.
   6. Mechanical sleeve seals.
   7. Grout.
   8. Concrete bases

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,
   crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and
   mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures
   and weather conditions. Examples include rooftop locations.

1.3 PERFORMANCE REQUIREMENTS
A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 65 psig minimum unless otherwise indicated.
B. Natural-Gas System Pressures within Buildings: Primary pressure is 2.0 psig for distribution.

1.4 SUBMITTALS
A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected
      models.
   4. Pressure regulators. Indicate pressure ratings and capacities.
   5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars
      and supports.
   6. Dielectric fittings.
   7. Mechanical sleeve seals.
   8. Escutcheons.
B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations,
   sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment
guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1. Shop Drawing Scale: 1/4 inch per foot (1:50).
2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.
C. Engineered Seismic Submittal: For natural-gas piping and equipment, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for seismic restraints.
D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
F. Qualification Data: For qualified professional engineer.
G. Welding certificates.
H. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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

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

1.8 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.
B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."
C. See Section 230510 for Concrete Bases’ requirements.
PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Above Ground Piping:
   1. Piping ½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.
   2. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS/2 and larger.
   3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   2. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   5. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
      a. BrassCraft Manufacturing Company; a Masco company.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.
1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
   a. Lee Brass Company.
   c. Conbraco Industries, Inc.; Apollo Div
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
   a. Flowserve.
   b. Homestead Valve; a division of Olson Technologies, Inc.
   d. Milliken Valve Company.
   e. Mueller Co.; Gas Products Div.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.

2.5 DIELECTRIC FITTINGS
A. Dielectric Unions:
1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
b. Central Plastics Company.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
f. Wilkins; Zurn Plumbing Products Group.

3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
   b. Central Plastics Company.
   c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   d. Wilkins; Zurn Plumbing Products Group.

3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E.
   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.6 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thunderline.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.8 ESCUTCHEONS
A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
B. One-Piece, Cast-Brass Escutcheons: With set screw.
   1. Finish: Polished chrome-plated.
C. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.
D. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
E. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.9 GROUT
A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

2.10 PRESSURE REGULATORS
A. All pressure regulators shall be designed, manufactured and approved for natural gas service.
B. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm. Manufactured by Rockwell or Fisher.
C. Install pressure gauge adjacent to and downstream of each line pressure regulator.

2.11 LABELING AND IDENTIFYING
A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.
B. Conform to section 220553 Identification for Plumbing Piping for piping labels.

2.12 MOTORIZED GAS VALVES
B. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E:
   1. ASCO Power Technologies, LP; Division of Emerson.
   2. Dungs, Karl, Inc.
3. Eaton Corporation; Controls Div.
4. Eclipse Combustion, Inc.
5. Honeywell International Inc.
6. Johnson Controls.

C. Body: Brass or aluminum.
D. Seats and Disc: Nitrile rubber.
E. Springs and Valve Trim: Stainless steel.
F. Normally closed.

G. Visual position indicator.
H. Electrical operator for actuation by appliance automatic shutoff device.
I. Electrically Operated Valves: Comply with UL 429.

J. Acceptable manufacturers, contingent upon compliance with the contract documents, are listed below. Equal products by other manufacturers are acceptable providing Substitutions are submitted in accordance with requirements listed elsewhere in the Bid Documents and approved by the A/E:

1. ASCO Power Technologies, LP; Division of Emerson.
2. Dungs, Karl, Inc.
3. Eclipse Combustion, Inc.
5. Magnatrol Valve Corporation.
6. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
7. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
8. ISIMET

K. Pilot operated.
L. Body: Brass or aluminum.
M. Seats and Disc: Nitrile rubber.
N. Springs and Valve Trim: Stainless steel.
O. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
P. NEMA ICS 6, Type 4, coil enclosure.
Q. Normally closed.
R. Visual position indicator.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
B. Inspect natural-gas piping according to International Fuel Gas Code and NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
C. Comply with International Fuel Gas Code and NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Replace pipe having damaged PE coating with new pipe.

B. Install fittings for changes in direction and branch connections.

C. 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.

D. 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.

E. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION


B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      c. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      d. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
      e. Piping in Equipment Rooms: One-piece, cast-brass type.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Walls or Partitions: Protect piping installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
   3. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use natural-gas piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

C. Install earthquake valves aboveground outside buildings according to listing.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Welded Joints:
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

E. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.7 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS
A. Connect to utility's gas main according to utility's procedures and requirements.
B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
C. Install piping adjacent to appliances to allow service and maintenance of appliances.
D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING
A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 PAINTING
A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      c. Topcoat: Exterior alkyd enamel flat.
      d. Color: Yellow
C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      c. Topcoat: Interior latex flat Color: Gray
      e. Topcoat: Interior alkyd flat
      f. Color: Yellow
D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to 2006 Uniform Plumbing Code and NFPA 54 and authorities having jurisdiction.
C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.12 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING
A. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, lubricated plug valve.
E. Valves in branch piping for single appliance shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

END OF SECTION 221006
SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
   2. Encasement for piping.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Architect/Engineer/Owner no fewer than five days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Architect/Engineer/Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
   B. Potable-water piping and components shall comply with NSF 14 and NSF 61.
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 and ASTM B 88, Type L water tube, annealed temper.
C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with mechanical-joint flanged ends.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
B. Standard- Pattern, Mechanical-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
C. Compact-Pattern, Mechanical-Joint Fittings:
   1. AWWA C153/A21.53, ductile iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys.
D. Flux: ASTM B 813, water flushable.
E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Tube.

2.6 TRANSITION FITTINGS

A. General Requirements:

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

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

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cascade Waterworks Manufacturing.
   b. Dresser, Inc.; Piping Specialties Products.
   c. Ford Meter Box Company, Inc. (The).
   d. JCM Industries.
   e. Romac Industries, Inc.
   f. Smith-Blair, Inc.; a Sensus company.
   g. Viking Johnson.
   h. Or approved equal.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.
   d. Jomar International.
   e. Matco-Norca.
   g. Watts; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

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

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.
G. Install domestic water piping level and plumb. Provide drain with hose fitting at all low points where possible.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on each supply to a restroom.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION
A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION
A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers, with insulation shield.
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-69 and manufacturer's written instructions.

3.7 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

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

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

3.12 PIPING SCHEDULE

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

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping, NPS 2-1/2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Under-building-slab, domestic water, building-service piping, NPS 3 to NPS 8, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   Do not install joints under building slab or underground.

F. Aboveground domestic water piping shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116
SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Backflow preventers.
      2. Temperature-actuated, water mixing valves.
      3. Hose bibbs.
      4. Wall hydrants.
      5. Drain valves.
      7. Flexible connectors.
   B. Related Requirements:
      1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, etc. in domestic water piping.
      2. Section 221116 "Domestic Water Piping".

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES
   A. Potable-water piping and components shall comply with NSF 61.
2.2 PERFORMANCE REQUIREMENTS

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

2.3 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
   b. Conbraco Industries, Inc.
   c. FEBCO; a division of Watts Water Technologies, Inc.
   d. Flomatie Corporation.
   e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   g. Or approved equal.

3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Size: Full line size.
5. Body: Bronze for NPS 2 and smaller; ferrous with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
   
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Ball type or butterfly with flanged ends on inlet and outlet.

B. Hose-Connection Backflow Preventers:

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. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   e. Or approved equal.

3. Operation: Up to 10-foot head of water back pressure & backsiphonage.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.
7. Location: Install at male-hose end drain valves and hose bibs.

2.4 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.
   d. Powers; a division of Watts Water Technologies, Inc.
   e. Symmons Industries, Inc.
   f. Or approved equal.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 85°F
9. Tempered-Water Design Flow Rate: 1.5 gpm
10. Pressure Drop at Design Flow Rate: 5 psi
11. Tempered-Water Minimum Flow Rate at setpoint temperature: 0.5 gpm.
13. Piping Finish: Copper.

2.5 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.

2.6 HOSE BIBBS

A. Hose Bibbs:
   5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
   8. Finish for Finished Rooms: Stainless steel or chrome plated.
   10. Operation for Rooms Accessible to the General Public: Operating key.
   11. Include operating key with each operating-key hose bibb.
   12. Include integral wall flange with each chrome- or nickel-plated hose bibb.
2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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:

   b. MIFAB, Inc.
   c. Prier Products, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products.
   g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
   i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
   j. Or approved equal.


4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.


7. Outlet:
   a. With integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7.

8. Nozzle and Wall-Plate Finish: Stainless steel or chrome plated.

9. Operating Keys(s): One with each wall hydrant.

B. Moderate-Climate Wall Hydrants:

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:

   b. MIFAB, Inc.
   d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   e. Zurn Industries, LLC.
   f. Or approved equal.


4. Operation: Loose key.


6. Outlet:
   a. With integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7.

7. Nozzle and Wall-Plate Finish: Stainless steel or chrome plated.

8. Operating Keys(s): One with each wall hydrant.
2.8 DRAIN VALVES

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

2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Stainless Steel.
8. Inlet: Threaded or solder joint.
10. Provide with hose-connection backflow preventer confirming to ASSE 1052.

2.9 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters HA-1*:

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:
   c. Watts Drainage Products.
   d. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
   e. Or approved equal.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes A and A through F, or PDI-WH 201, Sizes A through F.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.
11. Or approved equal.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers where indicated in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Do not install bypass piping around backflow preventers.

B. Install Y-pattern strainers for water on supply side of each control valve.

C. Install male hose-end drain valve with hose connection backflow preventer at all low points in the plumbing system.

D. Install outlet boxes recessed in wall or surface mounted on wall. Install wood blocking, wall reinforcement between studs.

E. Install water-hammer arresters in water piping according to PDI-WH 201.

F. Install air vents at high points of water piping.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each vacuum breaker and backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 221119
SECTION 221123 DOMESTIC-WATER PUMPS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following types of systems:
   1. Duplex variable speed booster pump packages.

1.2 REFERENCED STANDARDS

A. National Electrical Code Compliance: Components shall comply with NFPA 70, "National Electrical Code."

B. UL Compliance: Package shall be listed and labeled by UL, and comply with UL QCZJ. "Packaged Pumping Systems."

C. UL Compliance: Controller shall be listed and labeled by UL, and comply with UL 508A, “Industrial Control Panels.”

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.


G. ANSI/HI 9.6.3-1997 Operating Region


1.3 SUBMITTALS

A. General: In addition to procedures specified in Division 1, comply with the following.
   1. Tag submitted data with the corresponding designation of that item as scheduled in the construction documents. All information submitted shall be individually "tagged" to easily identify it with the corresponding material or equipment. Failure to comply with this requirement will result in that item or, at the discretion of the Engineer, all items submitted, being rejected without being reviewed.

B. Product data: Furnish catalog information, manufacturers package curve, rated capacities, final impeller dimensions, and accessories provided for the product indicated.
   1. A general arrangement drawing showing overall dimensions and all piping layouts.
   2. Complete submittal data for all major equipment (pumps, motors, valves, electrical controls, etc.).
   3. An electrical schematic, that provides power and control wiring.
   4. Sequence of operation.
   5. Indicate operating point of each pump on curves.
   6. Furnish composite curve for booster package.
C. Operation and Maintenance Data: Provide installation, operation and maintenance (IOM) manuals on all equipment, including assembly drawings as required for a complete explanation and description of all equipment.

1. Include installation instructions, maintenance instructions, assembly views, and replacement parts lists.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain pumps from a single manufacturer.

B. Each booster package shall be hydrostatically and flow tested prior to shipment to verify system integrity.

C. Pumps shall operate:

1. At specified system fluid temperatures without vapor binding and cavitation.
2. With variable speed controller to maintain specified discharge pressure and prevent motor overloads.


E. Pump pressure ratings shall be at least equal to the system’s maximum operating pressure at point where installed, but not less than specified.

F. ASME Compliance: Comply with ASME B31.9 for piping.

G. 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.

H. Provide certified equipment start-up and, when noted, an on site training session. Pump start-up shall be for the purpose of determining pump rotation, lubrication, voltage, and amperage readings. Start-up shall also include verification of proper electrical connections, pump’s balance, and recording of discharge and suction gauge readings. A copy of the start-up report shall be submitted to the Engineer.

I. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer’s Shipping Preparation: Provide flange covers for protection during shipping.

B. Store booster in a dry indoor location.

C. Retain shipping flange protective covers and protective coatings during storage.

D. Protect bearings and couplings against damage from moisture, sand, grit, and other foreign matter.
PART 2 – PRODUCTS

2.1 DUPLEX, VARIABLE SPEED BOOSTER PUMPING PACKAGE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Basis of design: SyncroFlo.
2. ITT Bell & Gossett
3. Armstrong
4. Grundfos
5. Or approved equal.

B. General Description: Factory-assembled and tested variable speed domestic water pressure booster system with pumps, piping, isolation and check valves, controls, specialties and accessories mounted on a structural steel base. Pump and electrical protection shall be integrated into the pump controller package. The package shall be arranged in a compact design to allow it to be moved through a standard 36” doorway.

C. Pumps:

1. Pumps shall be Stainless Steel Construction.
2. Impeller Construction: Stainless Steel Closed Impeller
3. Seals: Mechanical seals consisting of carbon rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.
4. Motor: Motor shall be NEMA design TC of size and type scheduled on drawings. Motors shall have a 1.15 service factor. Pump motors shall be secured to mounting frame.
5. Each pump shall be tested by its manufacturer at shut off and at a minimum of two other operating points at operating speed to verify performance.

D. Check valves: Angle style, pilot operated check valves shall be installed on the discharge of each pump. The valve shall have a fusion bonded epoxy coated ductile iron body with a bronze disc. The check valves shall be able to be serviced or rebuilt without removing them from the pressure booster. Direct acting check valves are not acceptable.

E. Isolation Valves: Two-piece, bronze body, full port ball valves shall be provided to isolate each pump and check valve.

F. Thermal protection: Self contained thermal-relief valves factory set to discharge at 125°F shall be mounted on each pump.

G. Piping: All piping shall be constructed from Type 304 stainless steel. Suction and Discharge headers shall be designed and constructed for minimal friction loss.

H. Pressure gauges: Pressure gauges shall be liquid filled, bourdon tube type. Gauges shall be supplied for both the suction and discharge headers.

I. Package Base: The pressure booster base shall be designed and fabricated to provide proper structural support for all attached equipment, and provide for anchorage to the structure. The base shall include a rigid structural member for pump and motor support. Main members shall be constructed from heavy weight A-36 structural steel members with reinforcing channels for larger boosters. Steel base shall be painted with machinery enamel.
J. Control Panel: Manufacturer shall provide a UL-508A listed complete electrical system including main disconnect, variable speed pump controller, pressure transducers, instrumentation and controls to automatically start, stop and modulate pump speed to smoothly, efficiently and reliably provide pump variable flow rates at a constant discharge pressure. The booster package shall include full pump, motor and drive safety features required to protect the equipment and piping system.

1. Main Control Panel: A door-operated non fused main disconnect shall be provided which shall remove power from the entire pressure booster when switched off. Each Variable Speed Drive (VFD)/Motor shall be protected by a molded case circuit breaker or MSP enclosed in the main control panel.

2. Motor Controller: NEMA ICS 7.1 variable-frequency, variable torque, solid-state pulse-width modulating type. VFD protective features shall include:
   a. Ground fault
   b. Short Circuit
   c. Motor overload

3. Suction and discharge pressure transducers.
   a. Pressure transducers shall be utilized for providing all pressure signals for the pump control logic. Pressure switches are not acceptable.
   b. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 1%. Transducer shall be constructed of non-ferrous metal suitable for used with domestic water. Pressure transducers constructed of plastic are not acceptable.
   c. Transducer shall be rated for package discharge and suction pressures as shown on submittal.
   d. Pressure transducer shall utilize a Packard type connector to prevent moisture intrusion.

4. Temperature Sensor
   a. A NTC thermistor or RTD shall be used for sensing the booster pumps’ discharge temperatures for temperature limit control logic. Thermostats are not acceptable.
   b. The temperature sensor shall be of the immersion type and shall be immersed in water from the pumps’ discharge. It shall be sealed of by a reusable compression type fitting allowing easy removal and insertion.

5. Controller: The pumping package controller shall provide a LCD four line display with 20 characters per line and programming keypad for data entry.
   a. Unit shall utilize user-friendly front panel programming that displays parameters in clear text.
   b. Display shall show all system variables in plain English.
   c. Program settings shall be changeable and stored in non-volatile memory. Program settings shall be retained in memory in the event of loss of power to the controller, without the use of a backup battery.
   d. System operating pressure shall be clearly displayed in PSI or feet of head for ease of use and to provide an operator friendly interface.
   e. Additional parameters, where applicable, shall be displayed in units consistent with pumping systems.
   f. The settings and program in whole or part may be locked out with the use of an operator selectable password. Standard system settings shall include at a minimum the following functions:
      1) Low suction pressure shutdown with auto restart
      2) High discharge pressure shutdown with lockout
      3) High discharge temperature shutdown
      4) Pump failure alarm
5) Constant pressure setting with variable flow capability
6) Multiple pump operation with alternation
7) Pump starting point with allowable, adjustable pressure drop
8) Minimum speed
9) No flow standby

6. Hydro-pneumatic Tank:
   a. Furnish hydro-pneumatic tank separately for field installation.
   b. Furnish tank of size pressure rating and construction specified on pressure booster schedule.
   c. Furnish hydro-pneumatic tank connection on discharge header with union, isolation valve and drain valve on discharge header of packaged pressure booster.

7. Sequence of Operation:
   a. The pump controller shall receive a 4-20mA signal from each pressure transducer.
   b. The pressure transducer shall monitor system discharge pressure and provide an analog signal to the pump control software, and allow the VFD motor controller to provide a variable Volts/Hz output to the motor.
   c. Whenever the pressure drops below the set system pressure, the lead pump shall start and run at speed required to maintain system pressure setpoint (as set by the operator.) If the pressure setpoint cannot be maintained by one pump, the lag pump shall start to provide the extra flow and pressure automatically.
   d. When demand decreases to a level which can be met by one pump and an adjustable minimum run-timer has elapsed, the lag pump will be stopped.
   e. The lead pump shall alternate based on elapsed run time.
   f. When the system experiences low demand the controller shall test for a no flow condition without the use of external switches or controls. The controller will stop the lead pump after verifying a zero demand condition exists and a minimum run-timer has elapsed. The hydro-pneumatic tank shall supply water to the system until the pressure falls below the restart pressure, at which point the lead pump shall restart.
   g. All program settings shall be based on centrifugal pump language.
   h. Program settings shall be password protected. With proper password entry, settings shall be field adjustable to allow changes by the user.

3. Control Interface: Provide with Bacnet connection to allow integration into the DDC Control System.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of pumps.

B. Examine rough-in for piping systems to verify actual locations of piping connections prior to installation.

C. Examine equipment foundations and/or inertia bases for suitable conditions where pumps are to be installed.

D. Correct unsatisfactory conditions prior to installation of pumps.
3.2 INSTALLATION

A. General: Comply with the ANSI/HI 1.4-2000 and manufacturer's written installation and alignment instructions.

B. Refer to the drawings for details of booster installation.

C. Install booster package in specified location. Provide access for periodic maintenance, including removal of motors, impellers, and accessories.

D. Verify proper pump rotation at start-up.

E. Perform start-up procedures per manufacturer’s instructions.

3.3 ADJUSTING

A. Adjust pressure and temperature setpoints.

END OF SECTION 221123
SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

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


B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE 7-10.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For coordination. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.
1.6 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS
A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect/Owner no fewer than five days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's/Owner's written permission.

PART 2 - PRODUCTS

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

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 74, Service class.
B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. Charlotte Pipe & Foundry.
      c. MIFAB, Inc.
      d. Mission Rubber Company; a division of MCP Industries, Inc.
      e. Tyler Pipe.
      f. Or approved equal.
   2. Standards: ASTM C 1540.
   3. Description: Stainless-steel shield, 0.015 inch minimum thickness, with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

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

D. 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.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.
   1. Adhesive primer for indoor applications shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement for indoor applications shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Shielded, Nonpressure Transition Couplings:
      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.

B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Hart Industries International, Inc.
      4) Jomar International Ltd.
      5) Matco-Norca, Inc.
      7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      8) Wilkins; a Zurn company.
      9) Or approved equal.
   b. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: 125 psig minimum at 180 deg F.
      3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Central Plastics Company.
      4) Pipeline Seal and Insulator, Inc.
      5) Or approved equal.
   b. Description:
      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Elster Perfection.
      2) Grinnell Mechanical Products.
      3) Matco-Norca, Inc.
      4) Precision Plumbing Products, Inc.
      5) Victaulic Company.
      6) Or approved equal.
b. Description:

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

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 PIPING INSTALLATION

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

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Sanitary Drainage Piping: 1/4” per foot downward in direction of flow for piping NPS 2 and smaller; 1/8” per foot downward in direction of flow for piping NPS 3 and larger.
2. Vent Piping: 1/8” per foot down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install underground PVC piping according to ASTM D 2321.

Q. Install engineered soil and waste drainage and vent piping systems as follows:


R. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

U. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION


B. 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.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads 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.

D. 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.

E. Plastic, Nonpressure-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. 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 small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install stainless-steel pipe hangers for horizontal piping.
2. Install stainless-steel pipe support clamps for vertical piping.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs: MSS Type 1, adjustable, clevis hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for 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.

I. Install supports for vertical copper tubing every 10 feet.

J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

K. Install supports for vertical PVC piping every 48 inches.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
   6. Equipment: Connect drainage piping as indicated. Provide shut-off valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.
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.

D.  Exposed PVC Piping: Protect plumbing piping exposed to sunlight with two coats of water-based latex paint. Coordinate color with Architect.

3.10  PIPING SCHEDULE

A.  Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B.  Aboveground, soil, waste, and vent piping shall be any of the following:
   1.  Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2.  Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
   3.  For stubouts through walls to fixture trap arm: Copper DWV tube, copper drainage fittings, and soldered joints.

C.  Underground Grease/Kitchen, soil, waste, and vent piping shall be the following:
   1.  Service class, cast-iron soil piping; gaskets; and gasketed joints.

D.  Underground, soil, waste, and vent piping except for Grease/Kitchen piping shall be the following:
   1.  Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316
SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cleanouts.
   2. Floor drains.
   3. Roof flashing assemblies.
   5. Flashing materials.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
   B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts, CO:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Josam Company.
      2) MIFAB, Inc.
      4) Tyler Pipe.
      5) Watts Drainage Products.
      6) Zurn Plumbing Products Group.
      7) Or approved equal.

2. Standard: ASME A112.36.2M for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts, FCO:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Josam Company.
      3) Watts Drainage Products.
      4) Zurn Plumbing Products Group.
      5) Or approved equal.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with tapered threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts, WCO:
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:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products.
   f. Zurn Plumbing Products Group.
   g. Or approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS
A. Cast-Iron Floor Drains: See Plumbing Fixture Schedule.

2.3 ROOF FLASHING ASSEMBLIES
A. Roof Flashing Assemblies:
1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES
A. Floor-Drain, Trap-Seal Fittings:
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. MIFAB, Inc.
b. Precision Plumbing Products, Inc.
d. RectorSeal
e. Or approved equal.

2. Description: Barrier, type, HDPE (High Density Poly Ethylene) housing with heavy duty silicone diaphragm and soft EPDM sealing gasket, conforming to ASSE 1072.
3. Size: Same as floor drain outlet.

B. Stack Flashing Fittings:

1. Description: Counterflushing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

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. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

H. Install floor-drain, trap-seal fittings on floor drains: barrier type conforming to ASSE 1072.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install vent caps on each vent pipe passing through roof.

K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft, 0.0625-inch thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319
SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

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

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7-10.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For coordination. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.
1.6 QUALITY ASSURANCE

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


1.7 PROJECT 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 Architect/Engineer no fewer than five days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Agency Project Manager’s written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

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

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ANACO-Husky.
   b. Clamp-All Corp.
   d. MIFAB, Inc.
   e. Mission Rubber Company; a division of MCP Industries, Inc.
   f. Tyler Pipe.
   g. Or approved equal.

3. Description: Stainless-steel shield, minimum thickness of 0.015”, with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.
   1. Adhesive primer for indoor applications shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement for indoor applications shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
   3. Shielded, Nonpressure Transition Couplings:
      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.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 PIPING INSTALLATION

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

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

   1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install underground PVC piping according to ASTM D 2321.

P. 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. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of aboveground exterior concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
3.3 JOINT CONSTRUCTION


C. Plastic, Nonpressure-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. 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 small differences in OD's.
   2. In Drainage Piping: Shielded non-pressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

   1. Install stainless-steel pipe hangers for horizontal storm piping.
   2. Install stainless-steel pipe support clamps for vertical piping.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, clevis hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

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.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.9 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.

D. Exposed PVC Piping: Protect plumbing piping exposed to sunlight with two coats of water-based latex paint. Coordinate color with Architect.

3.10 PIPING SCHEDULE

A. Aboveground storm drainage piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

B. Underground storm drainage piping shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221413
SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Thermostat-control, electric, tankless, domestic-water heaters.

1.3 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.

B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

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

B. Copies of test reports and start-up documentation from factory-authorized service representative.

1.6 QUALITY ASSURANCE

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

B. 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 1.
D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

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, Electric, Storage, Domestic-Water Heaters:
      1) Storage Tank: Three years.
      2) Controls and Other Components: One year.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, STORAGE, DOMESTIC-WATER HEATERS:

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:
   c. Lochinvar Corporation.
   d. PVI Industries, LLC.
   e. Rheem Manufacturing Company.
   f. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   g. State Industries.
   h. Or approved equal.

   a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      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 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.

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Electric, Tankless, Domestic-Water Heaters:
   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:
      b. Chronomite Laboratories, Inc.
      c. Eemax, Inc.
      d. Stiebel Eltron, Inc.
      e. Or approved equal.
   2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
   3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
      b. Pressure Rating: 150 psig.
      c. Heating Element: Resistance heating system.
      d. Temperature Control: Microprocessor-controlled thermostat.
      e. Safety Control: High-temperature-limit cutoff device or system.
      f. Jacket: Aluminum or steel with enameled finish.
   5. Capacity and Electrical Characteristics:
      a. See Drawings.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
   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. AMTROL Inc.
b. Bell & Gossett/Xylem.
c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
d. State Industries.
e. Taco, Inc.
f. Or approved equal.

2. 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.

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

4. Capacity and Characteristics:
   b. Capacity Acceptable: 7 gal minimum.

B. Drain Pans: Galvanized steel, minimum thickness, with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. 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.

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

2.4 SOURCE QUALITY CONTROL
A. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

B. Perform functional test of water heaters at the scheduled voltage to ensure equipment operation.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION
A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above grade on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. 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 220523 "General-Duty Valves for Plumbing Piping."

C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install thermometers on inlet and outlet piping of electric domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

E. Install electric tankless water heaters in NEMA 3RX vented enclosure, sized to accommodate water heater, junction box, and electrical connection.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to 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 220553 "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 preliminary tests and inspections.

C. Prepare test reports and start-up documentation to include in closeout materials.
3.5 DEMONSTRATION

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

END OF SECTION 223300
SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: Provide catalog cut sheets of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Closeout:
   1. Manufacturer's Instructions: Indicate installation, maintenance, operation, cleaning methods, and replacement procedures.
   2. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer. Warranty shall be minimum 1 year parts and labor.

1.2 QUALITY ASSURANCE

A. ANSI Standards: Comply with ANSI Standards pertaining to plumbing fixtures and systems.

B. ANSI Standards: Comply with ANSI A117.1 standard pertaining to plumbing fixtures for handicapped.

C. PDI Compliance: Comply with standards established by Plumbing and Drainage institute (PDI) pertaining to plumbing fixture supports.

D. Federal Standards: Comply with applicable Federal Standard FS WW-P-541/Series sections pertaining to plumbing fixtures.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. General: Provide factory-fabricated fixtures of the type, style and material indicated in the Plumbing Fixture Schedule. For each type of fixture, unless otherwise specified, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information, either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation.

2.2 MATERIALS

A. General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.

B. Provide materials that have been selected for their surface flatness and smoothness. Exposed surface which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration or other surface imperfections on finished units are not acceptable.

C. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units.
D. Unless noted otherwise, provide solid chrome-plated heavy cast brass (17 gauge) P-Trap with 2” minimum water seal and cast brass slip nut. Exposed P-Traps shall be fitted with cleanout plug.

E. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and speck; glaze exposed surfaces and test for crazing resistance in accordance with ASTM C 554.
Vitreous China Fixtures shall be white.

F. Comply with additional fixture requirements contained in the fixture schedule.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Lavatory Supply Fittings:
   2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size. Wheel handle operation.

D. Risers:
   1. Size: NPS 3/8 for lavatories and kitchen sinks, NPS 1/2 for tank-type water closets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing fixtures of types indicated where shown and at indicated heights or where not shown in accordance with manufacturer's written instruction, roughing-in drawings and with recognized industry practices.

B. Fasten plumbing fixtures and water supplies securely to supports or building structure, and ensure that fixtures are level and plumb and tight against mounting surface.

C. Seal the outer perimeter of wall mounted lavatories and urinals and water closets to the wall and floor mounted water closets to the floor with a smooth bead of white silicone compound.

D. Provide supply fittings for lavatories, sinks, and water closets.

E. Install flush handle accessible water closets with handle mounted on wide side of compartment.

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test and
adjust fixtures for proper operation.

3.3 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000