SECTION 22 01 00
PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide the plumbing additions and alterations as shown on the drawings, as specified in this Section, and as needed for a complete installation including, but not necessarily limited to:

1. Applications and fees for all plumbing permits, services, and interim and final inspections.
2. Temporary water provisions as required for construction purposes
3. Cold and hot water piping additions and alterations
4. Drain, waste, and vent systems
5. Plumbing equipment and trim
6. Cathodic and dielectric protection
7. Accessory plumbing devices including but not necessarily limited to hangers, supports, inserts and valves
8. Access panels
9. Piping insulation
10. Cutting and patching
11. Painting of exposed piping
12. Sterilization of the potable water system
13. Piping materials and installation instructions common to most piping systems
14. Dielectric fittings
15. Mechanical sleeve seals
16. Sleeves
17. Escutcheons
18. Grout
19. Plumbing demolition
20. Equipment installation requirements common to equipment sections
21. Supports and anchorages
22. Testing, adjusting and balancing

B. Include the cost of applications and fees for all plumbing permits, services, and interim and final inspections in the Base Bid.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 RELATED SECTIONS

A. Section 22 00 10 – Basic Plumbing Requirements

1.4 REFERENCES

A. International Plumbing Code.

B. State and local regulations.

1.5 SUBMITTALS

A. Submit in accordance with Section 22 00 10:

1. Shop Drawings: Provide piping drawings including connections to existing domestic water, sanitary drain, and vent risers. Indicate pipe materials used, joining methods, supports, and wall penetration seals.
2. Product Data: Provide manufacturers catalog information for purchased items. Indicate valve data and ratings, equipment dimensions and materials of construction.
3. Maintenance Instructions: Include installation instructions, spare parts lists, procedures, and treatment programs.

B. Welding certificates.

C. Field quality-control inspection and test reports.

D. Submit record drawings and final certification to the Owner and Engineer upon completion of installation and testing.

1.6 QUALITY ASSURANCE

A. Codes and Regulations

1. All materials, apparatus, and equipment and the installation thereof shall comply with all state and county ordinances and all other governmental and/or private authorities having jurisdiction, and shall comply with all county and state laws, rules, and regulations, as well as rules and regulations of the National Board of Fire Underwriters, and the Plumbing Code having jurisdiction.
2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern and shall be provided at no additional cost to the Owner.

B. Drawings and Coordination:

1. Construction drawings shall be considered as a part of the work, insofar as the drawings furnish information relating to design and construction of the building. Because of the scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required to meet such conditions.
2. The plumbing drawings show the general arrangements of all piping, ductwork, equipment, etc., and shall NOT BE SCALED. This work shall be coordinated with ALL trades. Critical locations are dimensioned on the drawings; if a conflict arises, the Engineer immediately for clarification.

C. Verify the dimensions governing the plumbing systems work in the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions and those indicated on the drawings. Examine adjoining work, on which mechanical work is dependent for proper operation, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to any failure to report unfavorable conditions affecting the plumbing systems work.

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

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

F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

G. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site. Store fixtures and valves in shipping containers with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.8 WARRANTY

A. Manufacturer’s Warranty: Provide the manufacturer's standard product warranty.

B. Installer’s Warranty: Include a copy of the Subcontractor’s Warranty for all work provided under the contract for construction for a term of 1 year after the Date of Substantial Completion.

C. Warranties shall be included in the Building Maintenance Manuals submitted to the Owner after the Date of Final Completion.

1.9 CLOSEOUT DOCUMENTS

A. Project Record Drawings: Record all changes as the work progresses on a set of project record drawings kept at the job site, and shall provide record drawings to the Owner after the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. The word piping shall mean pipe, fittings, nipples, valves, etc. completely assembled.

2.2 DOMESTIC AND NON-POTABLE WATER SYSTEMS

A. Water Lines: Copper: Type "L" hard drawn, per ASTM B88-7, for all water pipe above concrete or ground.

B. Fittings: Wrought copper, per ANSI B16.18 and B16.22.

C. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

D. Identification: Color identify pipe with size of pipe manufacturer's trademark, and conform to the following schedule:

1. Type "L" Copper – Blue

E. Soft rolled copper coil for trap priming lines installed below grade

2.3 JOINING MATERIALS

A. Refer to individual piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

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

D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressures at 225 deg F.

2.5 SANITARY AND STORM DRAINAGE SYSTEMS

A. Waste & Vent Lines: Cast Iron - Aboveground: Provide cast iron no-hub soil and vent pipe, coated inside and out, conforming to CISPI 301-69T Specifications, for all soil and waste lines above ground and for all vent lines with inside diameter 2 inches and larger. Standard weight soil and waste fittings will be accepted throughout. Pipe shall conform to CISPI Standard 301.

1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
   b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

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

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

2.6 ACCESS DOORS

A. The Plumbing Installer shall furnish access doors for the Contractor's installation in finished work for concealed valves, cleanouts, and to concealed parts of the plumbing system that

require accessibility for proper operation, maintenance, and repair. Doors are not required for suspended acoustical ceilings with lift-out panels.

B. Access doors shall be of the proper size for respective concealed items, with minimum size exclusive of other requirements, 18" x 18". Access door shall be flush type, with No. 13 U.S. Standard Gauge Steel door and trim, concealed hinges and screwdriver operated, stainless steel cam lock. Access door shall be shop painted with one coat of zinc chromate primer.

2.7 VALVES

A. Ball Valves: Nibco-Scott #T595, or #S595, 150# bronze body chrome plated ball, Teflon seats.

B. Valve Manufacturers: Provide as manufactured by Crane Jenkens, Walworth, Kennedy, Stockham, or Nibco-Scott.

2.8 PIPE HANGERS AND SUPPORTS

A. Adequately support piping against sagging, pocketing, swaying, and displacement. Properly space and apply hangers to achieve the result, and not farther apart than the following:

B. Copper Tubing:

1. 1-1/4" and smaller, 6 foot on center
2. 1-1/2" and larger, 10 foot on center

C. Size all hangers on insulated lines to fit around outside diameter of insulation specified with allowance for sheet metal shield. Pipe shield shall be 169A, 1/3 circumference of insulation of a length of not less than 3 x diameter of the insulation (maximum 24").

D. Manufacturer: Grinnell Company catalog numbers are indicated to simplify the description, however, hangers and supports shall be Grinnell, Grabler, Fee & Mason, Elcen or approved equal.

E. Overhead Supported: Each horizontal pipe shall be supported on adjustable wrought iron clevis hangers equal to Grinnell, Figure 260, except that groups of pipes shall be supported on trapeze hangers made up of steel rods and steel channels or angles. Pipe shall be "U" bolted to trapeze and trapeze spaced for the smallest pipe in the group.

F. Wall Supported: Horizontal piping mounted on walls shall be supported by cast iron bracket similar to Grinnell Figure 213, with Figure 260 Clevis type hanger attached.

G. Vertical Piping: Vertical piping shall be supported at floor level with Grinnell, Figure 261 supports, or equal.

H. Inserts: Inserts in concrete shall be similar to Grinnell, Figure 281 and shall be supplied and installed by this contractor.

2.9 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.10 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.11 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.12 PLUMBING SYSTEM INSULATION

A. All insulation shall be applied in a neat and workmanlike manner. Remove and replace all insulation not applied in strict accordance with manufacturer's specifications or not presenting a neat appearance. Insulation shall be continuous through wall and ceiling openings and sleeves.

B. Work Included: Pipe covering for non-potable & domestic hot and cold water piping. Condensate drainage piping below raised floors does not require insulation.

C. Materials and Installation: No pipe insulation shall be applied until piping has been pressure tested and approved. All insulation shall be applied strictly in accordance with the manufacturer's recommendations. Materials as manufactured by Johns Manville, Fiberglass, Phillip Carey, or Armstrong will be acceptable if equal to those specified. All insulation on indoor work shall have composite fire and smoke hazard ratings as tested by procedure NFPA 255 not exceeding: Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories, such as adhesives, mastics, cements, tapes, and cloth for fitting, shall have the same component ratings as listed above. Insulation shall have an average thermal conductivity not to exceed 0.25 BTU/inch of thickness per square foot per 1 degree F. at a mean temperature of 75 degrees F.

D. Non-Potable Water and Potable Water: All water piping and similar piping as further referenced, shall be insulated with 1" thick fiberglass insulated with foil kraft laminated vapor barrier fastened with pressure sensitive tape and staples 1" O.C. All fittings, valves, strainers, flanges, etc. shall be covered with a PVC fitting cover, taped and tack fastened. Condensate drainage piping below raised floors does not require insulation.

2.13 PIPE MARKERS

A. Pipe markers shall be Setmark wrap-around markers by Seton Nameplate Corporation. Markers shall be cylindrically coiled plastic sheets for pipes up to 4” size, and flat plastic wrap-around markers with nylon ties for 6” size and above. Markers shall be rated for a service temperature of 32º to 150º F. Pipe markers shall have lettering size based on pipe diameter, to be easily readable without overlapping.

2.14 EQUIPMENT TAGS

A. Valve tags shall be stock brass valve tags as manufactured by Seton Nameplate Corporation. Tags shall be 19 gauge thickness, 1½"diameter, with ¼" black-filled legend and ½" black-filled number.

B. Equipment tags shall be laminated plastic, minimum 1½" high, white background with ½" black-filled lettering. Furnish tags for equipment in system:

1. Trap priming units
2. Eyewash units

2.15 TRAPS

A. All floor drains are to be separately trapped as near to the floor drain as possible. Traps shall be self-cleaning, water-sealed, and shall have a scouring action. Traps shall be set true with respect to water seal. Traps shall be of the same material and size as pipes or branches into which they discharge.

2.16 VENTS

A. Connect vent piping to new vent through roof as indicated on the drawings.

2.17 CLEANOUTS

A. Where indicated on the drawings and as required by local plumbing code. Make all cleanouts accessible by one of the following means:

1. End cleanout, above removable ceiling tiles, or
2. Extending to floor or grade above.

B. Size: Same as pipe on which installed.

C. Installation: Covers set flush with finished floor or grade, to be securely anchored by means of integral lugs or bolts. Where surfacing materials such as resilient floor covering is used, install the clean out with top so that finished surface is smooth and flush.

D. Manufacturers: Cleanout products shall be as manufactured by Zurn.

E. End Cleanouts: Model Z-1470 bronze cleanout plug.

2.18 TRAP PRIMING UNITS (TP)

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Precision Plumbing Products, Inc.
2. Approved equal

B. Pre-assembled electronic timed trap priming unit

1. Atmospheric vacuum breaker
2. 120-volt solenoid valve
3. Preset 24 hour clock
4. Manual over ride switch
5. ¾" FNPT connection
6. Calibrated manifold for equal water distribution
7. ½" outlet compression fittings
8. Surfaced mounted 16-ga. steel cabinet with prime coat
9. Cylinder lock

2.19 EMERGENCY EYEWASH

A. Fendall 2000, 15 minutes flow duration, 6.87 gallons reservoir, wall mounted, 100% sterile saline solution, meets ANSI Z358.1-2009 requirements. Provide with wall mounting bracket, integrated waste containment, audio alarm, and alarm silencing button. Install where noted on the plan in each battery room.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Examine the areas and conditions under which work of this section will be provided, shall correct conditions detrimental to the timely and proper completion of the work, and shall NOT proceed until unsatisfactory conditions are corrected.

3.2 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to General Contractor.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.3 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

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

C. Aboveground, soil, waste, and vent piping shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings, gaskets and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless steel couplings and hubless-coupling joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Layout the plumbing system in careful coordination with the drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a properly operating system.

B. Follow the general layout shown on the drawings in all cases except where other work may interfere. Layout pipe runs to fall within the partition, wall or roof cavities, with no additional furring other than as specifically shown on the drawings.

C. Drainage and Vent Piping Systems:

1. 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."
2. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
3. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
4. Building Sanitary Drain and Horizontal Sanitary Drainage Piping:
   a. 2 percent (1/4” per foot) downward in direction of flow for piping NPS 3 and smaller
   b. 1 percent (1/8” per foot) downward in direction of flow for piping NPS 4 and larger
5. Vent Piping:
   a. 1 percent (1/8” per foot) down toward vertical fixture vent or toward vent stack
6. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
7. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

D. Drainage Specialties:

1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   a. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   b. Locate at each change in direction of piping greater than 45 degrees.
   c. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.
   d. Locate at base of each vertical soil and waste stack.
2. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
3. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   a. Position floor drains for easy access and maintenance, as indicated on the drawings.
   b. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   c. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
4. Install deep-seal traps on floor drains and other waste outlets.
5. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
6. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
7. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

E. Water Piping Systems:

1. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

2. 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.
3. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
6. Install piping to permit valve servicing.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Install piping to allow application of insulation.
11. Select system components with pressure rating equal to or greater than system operating pressure.
12. Install escutcheons for penetrations of walls, ceilings, and floors.
13. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
14. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
15. Verify final equipment locations for roughing-in.
16. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.5 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

   1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
   2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

H. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

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

B. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

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

3.7 INSTALLATION OF PIPING AND EQUIPMENT

A. General:

1. Make changes in directions with fittings; make changes in main sizes with eccentric reducing fittings. Unless otherwise noted, install water supply piping with straight side of eccentric fittings at top of the pipe.
2. Run horizontal sanitary drainage piping at a uniform grade of 1/8" per foot, unless otherwise noted. Run horizontal water piping with an adequate pitch upwards in direction of flow to allow complete drainage.
3. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the drawings.
4. Support piping independently at equipment, and similar locations, so that the weight of the pipe will not be supported by the equipment.
5. Securely bolt all equipment, isolators, hangers, and similar items in place.
6. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.
7. Provide complete dielectric isolation between ferrous and non-ferrous metals.
8. Provide union and shut-off valves suitably located to facilitate maintenance and removal of equipment and apparatus.
9. Install offsets, swing joints, expansion joints, pipe clamps, and anchors as required to permit expansion and contraction of piping system.
10. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
11. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
12. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
13. Install equipment to allow right of way for piping installed at required slope.

B. Workmanship:

1. Install all work pertaining to water, and drainage system as close as possible to layout shown on the drawings. Drawings are generally diagrammatic and all fixtures, equipment, and specialty items are to be located as shown on the drawing.
2. Connection to Equipment: Provide all plumbing and piping connections to equipment as specified including P-traps, and valves. Install valved and capped connections where indicated for continuation by others. Provide valves, ahead of all capped outlets.
3. Inspections: No piping in any location shall be concealed until it has been inspected and approved. All concealed work shall remain uncovered until tests have been completed. The drainage system shall be tested and proved tight under a water pressure test with nipples, ferrules, and connections being in place. All tests shall be conducted in the presence of the authorities having jurisdiction. If leaks or defects develop, new tests shall be made and repeated until all defects are remedied. Pipes or joints which leak shall be taken apart and be remade. No caulking shall be permitted. All labor, materials, as well as all costs and apparatus necessary for all tests, shall be furnished.
   a. Water System: 150 psi hydrostatic pressure held for four (4) hours.
   b. Soil and Vent System: Test by filling with water to highest point in the system.
   c. The water shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings shall be tightly plugged except at the highest point of the section under test. Each section shall be filled with water, but no section shall be tested at less than a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the previously tested adjacent section shall be tested so that no joint or pipe in the building shall have been submitted to a test of less than a 10 ft. head of water. The water shall be kept in the system or in the portion under test for at least 15 minutes before the inspection starts. The system shall then be proved tight at all points.
   d. After all plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and watertight.
4. Flushing and draining of system and cleaning of piping. Fill all piping systems with water and drain these systems before they are placed in operation, in order to remove foreign materials that may have been left on or deposited in the piping system during installation.
5. Clean-Up: Before acceptance of the work, clean all fixtures, trim and exposed piping, flush out all lines and leave the system ready for operation.

3.8 PIPE SUPPORTS

A. Support suspended piping with clevis or trapeze hangers and rods in accordance with products section.

B. Provide sway bracing on hangers longer than 18".

C. Support vertical piping with riser clamps secured to the piping and resting on the building structure. Provide at each floor unless otherwise noted.

D. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel shields.

E. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.

F. Do not support piping from inserts or anchors in concrete slabs. Provide trapeze hangers supported from structural steel components where required.

G. Hubless Piping:

1. Provide hangers on the piping at each side of, and within 6" of, hubless pipe coupling so the coupling will bear no weight.
2. Do not provide hangers on couplings.
3. Provide hangers adequate to maintain alignment and to prevent sagging of the pipe.
4. Make adequate provision to prevent shearing and twisting of the pipe and the joint.

H. Pipe hangers and supports:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

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

J. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

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

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

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

M. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.

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

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

3.9 SLEEVES AND OPENINGS

A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.

1. Set pipe sleeves in place as early as practicable.
2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between inside and outside of the pipe.
3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing and caulking.

B. Caulk the space between sleeve and pipe or pipe covering, with sealant as specified in the Sealants and Caulking Section, or pack with non-combustible packing material to within 1/2" of both wall faces and caulk.

C. Finish and Escutcheons:

1. Smooth up rough edges around sleeves with plaster or spackling compound.
2. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations. Size the escutcheons to fit pipe and covering. Hold escutcheons in place with set screw.

3.10 CLEANOUTS

A. Secure Architect approval of locations for cleanouts in finished areas prior to installation.

B. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger provide 4" cleanouts.

C. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

3.11 VALVES

A. Provide valves in water systems. Locate and arrange so as to give complete regulation of apparatus, equipment and fixtures.

B. Provide valves in at least the following locations:

1. In branches of water piping.
2. On both sides of apparatus and equipment.
3. For shutoff of risers and branch mains.
4. For flushing and sterilizing the system.
5. Where shown on the drawings.

C. Locate valves for easy accessibility and maintenance.

3.12 BACKFLOW PREVENTION

A. Protect other equipment having plumbing connection, against possible back siphonage.

B. Apply for permitting and arrange for testing of backflow devices as required by the local jurisdiction.

3.13 DISINFECTION OF WATER SYSTEMS

A. Disinfect cold water system additions and alterations:

1. Notify the Contractor at least 48 hours prior to start of the disinfection process.
2. Upon completion of disinfecting, secure and submit the Sterilization Certificate of Performance as part of the Closeout Documents specified elsewhere in this Section. The Sterilization Certificate of Performance must state capacity, disinfectant used, time and rate of disinfectant applied, and required residuals in ppm at completion.
3. Sterilization of Water Piping: After the domestic water piping has been pressure tested, the new portion system shall be thoroughly sterilized in accordance with the requirements of the health department having jurisdiction or, in the absence of such requirements, with a solution containing not less than 100 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine or U.S. Army Specifications 4-1, or calcium hypochlorite or chlorinated lime conforming to Federal Specifications O-C-114 and shall be introduced into the system in accordance with Federal Regulations. The sterilization solution shall be allowed to remain in the system for a period of 24 hours, during which time, all valve and faucets shall be opened and closed several times. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 5 ppm is indicated, repeat the sterilization process. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.

3.14 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.

3.15 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.16 LABELING AND IDENTIFYING

A. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each piece of equipment and valve.

C. General: Install pipe markers of one of the following types on each system and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 20' along each piping run. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

E. General: Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in a valve schedule for each piping system.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room

3.17 CLEANING

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

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

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION