

CONSTRUCTION STANDARD SPECIFICATION

SECTION 15401

PLUMBING

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CONSTRUCTION STANDARD SPECIFICATION

SECTION 15401

PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification, in conjunction with the design drawings and other contract documents, specifies materials and operations required for the installation of interior plumbing systems. Systems covered by this document are: domestic hot and cold water, non-potable water; sanitary waste, drain and vent; laboratory waste, drain and vent; roof drains; and indirect or special drains. Operations include the specification of piping, fittings, valves, joints, fixtures, equipment, tests, and disinfection.
- B. Pipe and fittings to be used for modifications or additions shall be the same material (galvanized steel, copper, etc.) as the existing systems being modified, and shall conform to the following unless otherwise indicated on the applicable contract drawings.

1.02 REFERENCES

The current editions of the following standards are to be considered a part of this specification.

- A. Sandia National Laboratories Standard Specifications
 - Section 01300 Submittals
 - Section 02200 Earthwork
 - Section 09900 Painting
 - Section 15050 Basic Mechanical Materials and Methods
 - Section 15083 Piping and Equipment Insulation
 - Section 15200 Vibration Limits and Control

B. American Society of Mechanical Engineers (ASME)

- B1.1 Unified Inch Screw Threads
- B1.2 Gages and Gaging for Unified Inch Screw Threads
 - B1.20.1 Pipe Threads, General Purpose (Inch)
- B16.1 Cast Iron Pipe, Flanges and Flanged Fittings
- B16.3 Malleable Iron Threaded Fittings Classes 150 and 300
- B16.4 Gray Iron Threaded fittings Classes 125 and 250
- B16.5 Pipe Flanges and Flanged Fittings
- B16.9 Factory-made Wrought Steel Butt Welding Fittings
- B16.11 Forged Steel Fittings, Socket Welding and Threaded
- B16.12 Cast Iron Threaded Drainage Fittings
- B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- B16.24 Bronze Pipe, Flanges and Flanged Fittings (Class 150 and 300)
- B16.34 Valves - Flanged, Threaded and Welding End
- B31.3 Process Piping

Boiler and Pressure Vessel Codes

C. American National Standards Institute (ANSI)

- Z358.1 Emergency Eyewash and Shower Equipment

D. American Society for Testing and Materials (ASTM)

- A53 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
- A74 Standard Specification for Cast Iron Soil Pipe and Fittings
- A307 Standard Specification for Steel Bolts and Studs, 60,000 psi Tensile Strength
- A518 Standard Specification for Corrosion Resistant High Silicon Iron Castings

- B88 Standard Specification for Copper Water Tube
- D3222 Standard Specification for Unmodified PVDF Molding Extrusion and Coating Materials
- D4101 Standard Specification for Propylene Plastic Injection and Extrusion Materials
- E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- F1412 Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
- F1673 Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems
- D. American Waterworks Association (AWWA): C651 Disinfecting Water Mains
- E. American Welding Society (AWS): A5.8 Specification for Brazing Filler Metal
- F. Cast Iron Soil Pipe Institute (CISPI)
 - 301 Cast Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems
- G. International Underwriters Laboratories, Inc. (UL)
- H. Code Council (ICC) – International Plumbing Code (IPC)
- I. Americans With Disability Act – Title 28 CFR Part 36 – ADA Standards for Accessible Design

1.03 SUBMITTALS

- A. Where specific manufacturer or model numbers are mentioned in these specifications, proposed substitutions shall be included in the submittal package.
- B. Submittals shall be as per Section 01300, “Descriptive Submittals”.
- C. Pipe materials, valves, equipment, and accessories not listed in this specification under PART - 2 - PRODUCTS shall be submitted for approval.
- D. Relief valves require submittals for approval.
- E. Backflow preventers require submittals for approval.

1.04 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Shall conform to ASME code for Pressure Piping, ASME B31.3, and Process Piping.
- B. Employ welders certified in accordance with ASME Boiler and Pressure Vessel Code, as modified by ASME B31.3, Process Piping.
- C. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME B31.3, Process Piping, for shop and jobsite brazing of piping work.
- D. Soldering: Conform to ASME B31.3, Process Piping and Copper Development Association recommended practices.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

The following products and materials shall be used unless shown otherwise on the drawings. Other manufacturers of products of equal or better quality and characteristics may be submitted on in addition to those listed in this specification. The manufacturers listed under this section supply products of acceptable type, quality, and performance.

2.02 PLUMBING MATERIALS

A. Potable Piping:

- 1. Plumbing for potable systems shall be lead-free per Public Law 99-339, Safe Water Act.
- 2. Lead-free is defined as no more than 0.2 percent lead in solder and solder flux, and no more than 8 percent lead in pipe and fittings.

B. Domestic Hot and Cold Water, Non-Potable Water, and Pressure Drain Piping:

- 1. Above Grade: Piping shall be Type L hard drawn copper tubing, ASTM B88, with wrought copper solder type fittings conforming to ANSI B16.22, or cast copper alloy solder joint fittings conforming to ANSI B16.18, or cast copper alloy flanged fittings Class 150 conforming to ANSI B16.24. Screwed joints in piping are restricted to pipe sizes 2" and smaller.

Exception: Modifications to existing steel systems may use schedule 40, galvanized steel pipe, ASTM A53, Grade A or B, with 150 pound galvanized malleable iron screwed fittings conforming to ANSI B16.3.

2. Below Grade: Type K copper tubing shall be used. Fittings shall be flared solder type of brass, bronze or wrought copper. When piping is installed within a building and in or under a concrete slab, is shall be installed without joints were possible and where joints are required they shall be brazed.
- C. Soil, Waste, Drain, and Vent Piping: Cast iron soil pipe, fittings and connections shall comply with CISPI guidelines.
1. Below Grade: Piping shall be service weight hub and spigot (with gasket) coated cast iron and shall conform to ASTM A74.
 2. Above Grade: Piping shall be Schedule 40, galvanized steel pipe, ASTM A53, with threaded, galvanized cast iron Durham drainage fittings, ANSI B16.12; or DWV copper pipe with solder joint DWV wrought copper fittings; or service weight hub-spigot (with gasket) coated cast iron pipe and fittings conforming to ASTM A74; or hubless cast iron pipe and fittings conforming to CISPI 301.
- D. Laboratory/Process/Acid Waste And Vent Piping: For acid and caustic resistant drains.
1. From lab waste to neutralizing tank and vent piping: Pipe and fittings shall be flame retardant Schedule 40 Polypropylene (GF "Fuseal II" PPFR Group 1 63153 or Enfield "Enfusion" Type II-37206) or polyvinylidene fluoride (PVDF)(Fuseal 25/50 PVDF). Polypropylene pipe shall conform to ASTM F1412 and ASTM D4101. The PVDF pipe shall conform to ASTM F1673, ASTM E84, and ASTM D3222. Joints and fittings shall be DWV electric fusion made of the same material as the piping.
 2. From neutralizing tank to sewer main: Pipe and fittings shall be per Soil, Waste Drain and Vent Piping above.
 3. Connection to equipment and fixtures in accessible locations shall be made with mechanical joints.
 4. Connection to existing systems of different materials shall be made with the appropriate adapter provided by the Contractor.
- E. Roof Drain Leaders:
1. Below Grade: Leaders shall be service weight hub and spigot coated cast iron and shall conform to ASTM A74.
 2. Above Grade: Schedule 40 galvanized steel pipe, ASTM A53, with galvanized cast iron screwed drainage fittings, ANSI B16.12; or service weight hub-spigot coated cast iron pipe and fittings conforming to ASTM A74; or hubless cast iron pipe and fittings conforming to CISPI 301.

- F. Equipment Drains And Indirect Waste: Piping shall be Schedule 40 galvanized steel pipe, ASTM A53, with galvanized cast iron screwed drainage fittings conforming to ANSI B16.12 or DWV copper pipe with DWV wrought copper fittings in compliance with ANSI B16.29.

2.03 VALVES

A. Gate:

1. 1 Inch and Smaller: Class 125, solder or threaded ends, bronze body, rising stem, screwed bonnet, and solid wedge. Nibco S-111 or Nibco T-111 or equivalent.
2. 1¼ Inches to 2 Inches: Class 125, threaded ends, bronze body, rising stem, screwed bonnet, and solid wedge. Nibco T-111 or equivalent.
3. 2½ Inches and Larger: Class 125, flanged ends, OS&Y, iron body, bronze trim, rising stem, and solid wedge. Nibco F-617-0 or equivalent.

B. Ball:

1. 2 Inches and Smaller: bronze body, blow-out proof captive stem, double Teflon seats, full ported, stainless steel or chrome plated brass ball, 2-piece, threaded or soldered ends. Nibco T-585-70 or S-585-70. Or a 3-piece bronze body, full port, stainless steel trim, with a blowout-proof stem. Nibco T or S-595-Y or equivalent.
2. 2½ Inches to 3 Inches: Two or three-piece bronze body, blow-out proof captive stainless steel stem, double Teflon seals and seats, full ported, stainless steel or chrome plated brass ball and threaded ends. Nibco T-585-70-66 or Nibco T-585-Y.
3. 4 Inches and Larger: Class 150, flanged ends, carbon steel body with 316 stainless steel trim, uni-body design, full ported, blow-out proof captive stainless steel stem and ball, and Teflon seat. Nibco F-510-CS-R-66-FS.

C. Globe:

1. 2 Inches and Smaller: Class 125, screwed ends, bronze body, inside screw, screw-in bonnet, renewable seat and disc. Nibco T-211 or equivalent.
2. 2½ Inches and Larger: Class 125, iron body conforming to ASTM A126 Class B, bronze trim, flanged ends, bolted bonnet, bronze disc, replaceable seats. Nibco F-718-B or equivalent.

D. Butterfly:

1. 2½ Inches through 6 Inches: 200 psi working pressure, iron body, aluminum/bronze disc, stainless steel shaft, resilient seat, O-ring seals, lug type for dead-end service, lever operator. Nibco LD2000 series.
2. 8 Inches and Larger: 150 or 200 working pressure, iron body, aluminum/bronze disc, stainless steel shaft, resilient seat, O-ring seals, lug type for dead-end service, gear operator. Nibco LD1000 or LD2000 series dependent on the application.

E. Check Valve:

1. 2 Inches and Smaller: Class 125, threaded ends, bronze body, Y pattern, renewable seat and disk, and screw cap. Nibco T-413 or equivalent.
2. 2½ Inches and Larger: Class 125, iron body, silent check, flanged ends, globe style, spring actuated, renewable seats and disc, bronze trim or 316 stainless steel trim. Nibco F-910 or equivalent.

F. Vertical Check: 2 Inches and Smaller: Class 125, threaded ends, bronze body, spring actuated, inline vertical lift type, TFE seat ring. Nibco T-480-Y or equivalent.

G. Needle: 1 Inch and Smaller: Rated at 600 psi and 300°F, positive shut-off for gauges, brass. Weiss Instruments 25NVBR or equivalent.

2.04 STRAINERS, FLANGES AND UNIONS

A. Strainers:

1. 2 Inches and Smaller: Threaded ends, cast bronze body with screwed cap, and 20-mesh 304 stainless steel screen for water service. Conbraco 59-000 series or equivalent.
2. 2½ Inches and Larger: Flanged ends, cast iron body and bolted cap, 20-mesh stainless steel screen for water service. Conbraco FC1 or equivalent.

B. Flanges:

1. 1-1/2 Inches and Smaller: Class 150, forged steel, screwed, ANSI B16.5.
2. 2 Inches and Larger: Class 150, forged steel welding neck, ANSI B16.5.
3. Copper Systems: Class 150, Cast Copper, ANSI B16.23.

C. Unions:

Piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings prescribed with which they are used. Union pressure classes and end connections shall be the same as the fittings used in the lines with the unions.

1. Steel unions shall have hardened stainless steel seating surfaces on both faces.
2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
3. Dielectric unions shall not be used to join two dissimilar materials (ferrous and non-ferrous metallic.) Use Brass fittings, valves or unions to join dissimilar materials.

2.05 CLEANOUTS

- A. Floor Cleanout: Fully adjustable, coated cast iron body with nickel bronze scoriated top. Zurn ZN-1400 (Normal Traffic) or ZN-1400-HD (Heavy Traffic)
- B. Wall Cleanouts: Coated cast iron body with ABS plug and smooth stainless steel access cover. Zurn Z-1441 or Z-1445.
- C. Acid Resistant Cleanouts: Cleanouts for acid resistant waste lines shall be of the same material as the connecting waste pipes or approved equal.

2.06 PLUMBING FIXTURES

Unless specified otherwise on the contract drawings, provide plumbing fixtures as listed below. Ordinary plumbing fixtures are specified here. Refer to the contract drawings for laboratory and special equipment. Fixtures shall be white and furnished with all trim and accessories required for a complete installation. Fixtures shall be provided with stop valves on both hot and cold water supplies. Metal trimmings on fixtures and exposed piping to fixtures, unless otherwise noted, shall be chromium plated with chromium-plated escutcheons. Toilets and lavatories shall be mounted on Sandia Delegated Representative (SDR) approved carriers or as indicated on the drawings.

Flushometer valves shall be Sloan or Zurn. No substitutions allowed. If different manufactures are specified on the contract drawings, an equivalent Sloan or Zurn shall be supplied.

A. Toilets

1. Floor Mounted, Tank Type: American Standard elongated "Cadet", 2998.012 (18" high) or 2898.012 (14" high) elongated bowl, water saver, siphon jet closet, Olsonite #95 open front seat.
2. Floor Mounted, Flush Valve Type: American Standard "Madera", No. 2305.100, water saver, siphon jet closet, elongated bowl with Sloan Royal #111 flush valve and Olsonite #95 white open front seat.
3. Wall hung, Flush Valve Type: American Standard "Afwall", No. 2257.103, water saver, top spud, siphon jet closet, elongated bowl with Sloan Royal 111 flush valve, Olsonite #95 white open-front seat.

B. Urinal:

American Standard "Washbrook", No. 6501.010, wall-hung with Sloan Royal 186-1.0, 1.0 gpf flush valve and approved wall hanger.

C. Lavatories & Faucets:

1. Kohler "Farmington", No. K2905-4, in-counter mount self rimming, white enameled cast iron oval bowl, 4 in. faucet centers.
2. Kohler "Hudson", No. K2861, wall-mount, white enameled cast iron bowl, 4 in. faucet centers.
3. Faucet: Chicago Faucets No. 802-317CP, 4 inch centers with integral spout, wrist blade handles, ADA compliant, solid brass body and spout, heavy chrome plate finish, quarter turn self-contained cartridge, pressure compensating 2.2 GPM.

D. Service Sink:

Kohler, No. K-6710, Floor-mounted, white enameled cast iron, with wire rim guard, chrome faucet with lever handles, vacuum breaker, rubber hose and wall hook, with No. K9146 perforated strainer.

E. Wall Hydrant:

1. Walls with Exposed Finished Interior- Zurn No. Z-1333, Moderate Climate, ¾" hose connection, with anti-siphon, automatic draining, polished brass with operating key.
2. Walls at Partitions or with Unfinished Interior - Zurn No. 1310, Exposed, non-freeze, anti-siphon, automatic draining, polished bronze face, ¾" hose connection, and operating key

F. Drinking Fountains, Electric:

New drinking fountains shall be barrier-free. Haws Model No. HWCA8. Wall mounted, steel with baked enamel finish, 7.5 GPH at 80oF inlet, 90oF ambient, 115/60/1, R134 refrigerant, provided with 3 wire grounding type cord and plug, UL listed.

G. Emergency Shower and Eyewash:

1. Inside: emergency showers and eyewash stations are to be barrier-free. Bradley, Model No. S19-310BF, stainless steel bowl and Face Spray Ring. Provisions for vertical or horizontal supply. Shower valve to be 1" IPS stay-open ball valve. Eyewash valve to be 3/4" IPS stay open hand operated ball valve. Units shall meet ANSI Z358.1.
2. Outside: emergency showers and eyewash stations are to be frost proof. Bradley Model No. S19-310HFP, stainless steel bowl and face spray ring. Provisions for vertical or horizontal supply. Shower valve to be 1" IPS stay-open ball valve. Eyewash valve to be 3/4" IPS stay open hand operated ball valve. Units shall meet ANSI Z358.1.

2.07 EQUIPMENT

Equipment required for installation on this contract shall be as specified and as shown on the applicable contract drawings and shall be furnished complete with accessories normally supplied with the catalog item listed and other accessories necessary for a complete and satisfactory operating system.

A. Domestic Water Heaters:

1. Domestic water heaters shall be commercial grade, stock catalog item of standard manufacturer, glass lined, and unconditionally guaranteed for a minimum of 10 years. Insulation shall be fiberglass with minimum R-value of 5. Tank shall be nameplate rated for 127.5 psig (minimum working pressure) and shall be constructed. For input ratings 200,000 BTUH and above certified and stamped to meet ASME Boiler and Pressure Vessel Code.
2. Two copies of the manufacturer's Data Sheets shall be submitted to the SDR for approval and record keeping.
3. Dip tubes, hot and cold water supply nipples, and baffles or heat traps used in the tank shall be made to withstand a temperature of 400oF without deteriorating in any manner.
4. Gas burners shall be of the high recovery type and AGA and UL listed. Electric water heaters shall be UL listed.

5. Water heaters shall be provided with ASME Boiler and Pressure Vessel Code certified and stamped combination temperature and pressure relief valves with test lever.

B. Hot Water Storage Tanks:

1. Tanks shall be constructed, certified and stamped to meet ASME Boiler and Pressure Vessel Code. Tanks shall be glass lined, and provided with a thermometer and thermometer well installed at the points where the water enters and leaves the tank.
2. Tanks 80 gallons and larger shall have a 12" x 16" manhole.
3. Tanks, regardless of size, shall be provided with an ASME combination temperature and pressure relief valve with test lever.
4. Two copies of the manufacturer's Data Sheets shall be submitted to the SDR for approval and record keeping.
5. Temperature and Pressure Relief Valves:
6. All temperature and pressure relief valves shall be in compliance with UPC.
7. Relief valves shall be factory set; ASME listed, certified, and stamped.
8. Relief valves shall be sized to relieve the unregulated capacity of the Pressure Regulating Valve (PRV), burner, or heating element.

PART 3 - EXECUTION

3.01 PLUMBING INSTALLATION

A. Contamination Prevention:

1. Pipe interiors shall be kept free of debris.
2. Interior surfaces of potable water pipes, valves and fittings shall be protected against contamination, as well as debris. All openings in pipelines shall be closed with watertight plugs when work is halted on the system. Sealing and packing materials shall not support the growth of bacteria. Trenches that become wet shall be treated with calcium hypochlorite granules to prevent bacterial growth.

B. General:

1. Plumbing accommodations in government facilities shall conform to 28 CFR Part 36, Nondiscrimination on the Basis of Disability by Public Accommodations in Commercial Facilities.
2. The installation of the plumbing systems shall conform to the International Plumbing Code (IPC) and this specification.
3. Plumbing installation shall be coordinated with respect to space available for heating, ventilating, and electrical installation. In case of conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows; shall not encroach on aisles, passageways, and equipment; and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Pipe shall not be bent. Cutting or weakening of structural members to facilitate piping installation is not permitted.
4. Plumbing installation shall maintain the working spaces around electrical equipment as required by NEC. Replacement of existing metal water piping shall not occur without first ascertaining how the electrical ground system is configured.
5. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1" in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings. Service pipe, valves, and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2" from such other work, and not less than 1/2" between finished covering on the different services.

C. Reducers: Reduction in pipe sizes shall be made with one-piece reducing fittings. Forged bushings reducing at least two pipe sizes will be acceptable only when there is no room for manufactured reducing couplings or swaged nipples. Cast bushings are not acceptable.

D. Unions: Unions shall be installed at all equipment, instruments, relief valve discharge lines, and down stream of threaded valves.

E. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified. Gate valves shall be used unless otherwise shown, specified, or directed by the Sandia Delegated Representative (SDR). All valves shall be installed with their stems between the horizontal the 90-degree vertical. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used. Provide access to all concealed valves by means of access doors furnished and installed by the Contractor.

F. Hangers and Supports:

1. Piping, unless otherwise directed by governing documents or the SDR, shall be rigidly supported from the building structure by means of adjustable ring-type hangers. (WELDING TO BUILDING STRUCTURE WILL NOT BE PERMITTED.) Where pipes run side by side, support on rod and angle iron or Unistrut trapeze hangers. Hanger spacing shall be as follows:

<u>Steel Piping</u>	<u>Maximum Spacing</u>
3/8" and under	4'-0"
1/2" through 1"	7'-0"
1-1/4" through 4"	10'-0"
5" through 8"	16'-0"
10" and larger	20'-0"

<u>Copper Piping</u>	<u>Maximum Spacing</u>
3/8" and under	4'-0"
1/2" through 3/4"	6'-0"
1" through 1-1/2"	8'-0"
2" and larger	10'-0"

<u>Plastic Piping</u>	<u>Maximum Spacing</u>
All sizes	4'-0"

<u>Cast Iron Piping</u>	<u>Maximum Spacing</u>
5' lengths	5'-0"
10' lengths	10'-0"
Hubless	At every joint

2. Round rods supporting the pipe hangers shall be of the following dimensions:

3/8" to 2" pipe	3/8" rod
2-1/2" to 3" pipe	1/2" rod
4" to 5" pipe	5/8" rod
6" pipe	3/4" rod
8" through 12"	7/8" rod
14" through 16"	1" rod

3. Rods for trapeze hangers shall be a minimum of 3/8" and shall have the equivalent cross section listed above per pipe supported. The use of pipe

hooks, chains, perforated iron strapping or wire for pipe supports WILL NOT be permitted.

4. Hanger rods shall be galvanized carbon steel per ASTM A307, Grade B, threaded per ANSI B1.1 coarse thread series, Class 2A fit. Hanger rods shall have minimum 6" threaded ends. Double nut all hangers or use a safety tab.
5. Place a hanger within 1'-0" of either side of each horizontal elbow.
6. Hanger rods shall be installed vertically. No offset in hanger rods will be permitted.
7. Use hangers which are vertically adjustable 1-1/2" minimum after piping is erected.
8. Use copper straps on copper pipe and ferrous hangers on ferrous pipe.
9. Soft copper tubing, where permitted, shall be fastened to the building structure with Unistrut-type copper pipe clamps and spaced not more than 4'-0" apart.
10. Fasten vertical pipes to rigid structural members at each floor or at 10'-0" maximum spacing, unless otherwise directed.
11. On 4" and larger piping, install hangers adjacent to (within 1'-0" on each side) all strainers, check valves, valves, and all flanged items.
12. "C" clamp style hanger shall only be installed with retaining clip.
13. Insulated pipes shall be protected using galvanized steel shield similar to Grinnel Figure 167 or 360° galvanized steel shield by Pipe Shields Inc. or an SDR approved equal.

G. Joints:

1. Cast iron pipe joints shall be made in accordance with the International Plumbing Code.
 - a. Compression joints for bell and spigot pipe shall have flexible, compression factory-fabricated joints composed of a neoprene gasketing system in accordance with IPC.
 - b. Hubless joints shall conform to standard specification 301 of the Cast Iron Soil Pipe Institute in above ground systems.
2. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be machined flush. All flange boltholes shall straddle the horizontal and vertical centerlines unless otherwise noted. Bolting shall comply with ANSI/ASME B31.3, Process Piping.

- a. Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.
 - b. The following procedure shall be followed when making final assembly of a bolted flange joint.
 - (1) Place the gasket on the gasket seating surface and bring the cover flange in contact with the gasket. Do not glue the gasket in place.
 - (2) Install all bolts, making sure they are free of dirt and grit, and are well lubricated.
 - (3) Run-up all nuts finger tight.
 - (4) Develop the required bolt stress in a minimum of four steps: (1) stress the bolts to about 30% of their required stresses, tightening one bolt after another in a clockwise motion, (2) stress to about 60%, tightening each bolt one after the other in a clockwise manner, (3) tighten to about 90%, and (4) perform final tightening, again in a clockwise manner.
3. Screwed Joints: Screwed pipe joints shall have Pipe Threads, General Purpose (Inch), ASME B1.20.1. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. The joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.
4. Brazed/Soldered Joints:
- a. Cut tube ends square. Ream, remove burrs, and size.
 - b. All joints in piping systems with pressure above 100 psig or service temperatures above 200 °F shall be brazed.
 - c. Brazed copper-to-copper joints shall be made with a silver-brazing alloy conforming to AWS A5.8, BCuP-5 (15% silver). Joints shall comply with ANSI/ASME B31.3 Process Piping.
 - d. Brazed copper to brass, or copper to stainless steel joints shall be made with a silver-brazing alloy conforming to AWS A5.8, BAg-7 (45% silver). Joints shall comply with ANSI/ASME B31.3 Process Piping.
 - e. All solder joints, for copper tubing, shall conform to recommend practices of the Copper Development Association, and shall be made with 95-5 tin-antimony solder with the following exception:

Solder containing antimony shall not be used to join metals containing zinc (e.g., galvanized iron, galvanized steel, and brass).
 - f. Use sand cloth or a steel wire brush to clean surfaces to be joined. Steel wool is not permitted.

H. Cross-Connection Control:

1. A backflow prevention assembly (BFP) shall be installed to prevent cross-connection contamination between potable water systems and non-potable or potentially polluted, or contaminated systems, such as drainage systems, soil lines, fire protection lines or chemical lines.
2. All potable water fixture outlets with hose attachments, such as hose bibbs, yard hydrants, janitor sinks and lab sinks, shall be protected by an approved (SDR) vacuum breaker device.
3. Do not install backflow prevention assemblies (BFP) higher than 6 feet above the finished floor without approval of the SDR.
4. Backflow prevention (BFP) assemblies shall be approved by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR).
5. Backflow prevention assemblies used or installed under this contract shall be tested by a "Certified Backflow Control Assembly Tester" who possesses a current (within three (3) years from date of issuance) certificate that confirms successful completion of an approved (SDR specified or USC-FCCCHR or Colorado Environmental Training Center, Golden, Colorado) training course.
6. The Contractor shall perform an operational test on any new or relocated backflow prevention assemblies used or installed under this contract. Passing backflow preventers shall be labeled with a tag indicating: test performed, tester's initials and date. Testing documentation shall be submitted to the Sandia Delegated Representative (SDR).
7. Repairs to BFPs shall be made with original manufacturer's parts.
8. Piping downstream of BFPs shall be labeled "Non-Potable" or "NPW" in accordance with Section 15050, "Basic Mechanical Materials and Methods".

I. Drains:

1. Drains indicated on the drawings in connection with water distribution systems shall be 3/4" bronze valves (ball) with bronze caps or plugs, unless otherwise noted.
2. Additional drains shall be installed at low points on the hot water and cold water piping to ensure proper draining of the system, and all piping shall pitch to the drains. Hose bibbs (3/4"), with integral vacuum breaker, shall be provided as drain valves at low points.

- J. Equipment Connections:
1. All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment.
 2. The Contractor shall be required as directed by the Sandia Delegated Representative (SDR), to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected.
 3. Pipe connections to equipment shall be made with unions, flex connectors, flanged fittings or grooved couplings.
 4. Eccentric reducers are required at pumps and other equipment for air removal.
 5. Install water heaters per IPC.
- K. Air Chambers (Shock Absorbers): Sizes and locations of shock absorbers shall be as indicated on the drawings and shall be installed in an easily accessible location.
- L. Joining Dissimilar Materials (Copper to Steel): Use brass nipples, brass valves, or brass unions between copper and steel piping 2" and smaller. Use dielectric flanges on larger piping. Dielectric unions shall not be installed between dissimilar materials.
- M. Insulation of all pipes, valves, fittings, and equipment shall be in accordance with Section 15083, "Pipe and Equipment Insulation" unless noted otherwise on the drawings.
- N. Identification and Labels: All plumbing systems shall be labeled and identified in accordance with Section 15050, "Basic Mechanical Materials and Methods".
- O. Chlorine Injection Port: A 3-way ball valve or an SDR approved cleanout port shall be installed on the new line directly off of the existing main to aide in the sterilization tests of new water lines.
- P. Relief valves:
1. Discharge from relief valves located inside buildings shall be piped full size and extended a floor sink or to the outside of the building. Potable water lines shall either be turned down towards the ground and terminated between 6" and 2 feet above the ground, or be piped to a drain. Potentially contaminated lines must be directed via pipelines to a closed drain. Piping shall be sloped 1/8" per foot.
 2. No valves of any type shall be placed between the relief valve and the equipment to be protected.
 3. Install a union on the discharge of relief valves with threaded connections.

- Q. Escutcheons shall be provided at wall, ceiling and floor penetrations of piping in occupied areas.
- R. Access doors shall be provided where maintenance access is required (at shut-off valves, trap primers, shock absorbers, BFPs, etc.)

3.02 SOIL, WASTE, AND VENT PIPING INSTALLATION

- A. Install Soil, Waste, and Vent Piping in accordance with the International Plumbing Code (IBC).
- B. All excavation and backfill shall be in accordance with 02200, "Earthwork".

3.03 POLYPROPYLENE and PVDF PIPING INSTALLATION

- A. General: Fusion and mechanical joints shall be installed by experienced pipe fitters and as per the manufacturer's instructions. The Contractor shall provide all tools and equipment necessary for proper installation. The contractor shall provide for supports and thermal expansion to meet the manufactures recommendations
- B. Horizontal Piping: Support horizontal piping at end of branches, and at change of direction or elevation. Clamp piping where shown to control thermal expansion, per manufacturer's recommendations.
- C. Vertical Piping: Support risers with standard riser clamp or wall brackets.
- D. Mechanical Joints: Circumferential grooves in the pipe shall not exceed 0.030 inches depth when mechanical joints are used.
- E. Air Plenums: Piping installed in air plenums shall be installed with piping materials that have a flame/smoke rating of 25/50 or less per ASTM E84 or piping shall be wrapped with 3M Fire Barrier Plenum wrap to meet a flame/smoke rating of 25/50 or less per ASTM E84.

3.04 FIXTURE AND EQUIPMENT INSTALLATION

- A. General: All fixtures and equipment shall be installed complete with all accessories and trim required for proper installation.
- B. Fixtures: Fixtures shall be firmly bolted to wall, floors, or carriers in accordance with the manufacturer's roughing-in and setting requirements and drawings. The Contractor shall make proper provision for hanging and setting fixtures and accessories during building construction. Where "rough-in only" is specified, rough-in shall include stop valves on all service lines and waste line shall be capped, ready for installation of trap by others. All fixtures shall be installed square with the wall, in line, and level to provide a workmanlike and uniform appearance.
- C. Equipment: Equipment shall be installed in accordance with the manufacturer's directions and shall be supported and fastened in a satisfactory manner. Piping connections to the equipment shall be made with union or flanged connections for

easy removal and shall be installed without strain at the pipe connection to the equipment. The Contractor may be directed to disconnect the unions or remove the flanges to demonstrate unstrained alignment.

- D. Traps: Each fixture and piece of equipment connecting to the drainage system shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double-trapped.

3.05 TESTS

- A. General: All plumbing, piping, equipment, and fixtures installed under this contract shall be inspected and tested before insulation is installed, by the Contractor in the presence of the Sandia Delegated Representative (SDR), and approved before acceptance. The Contractor shall furnish all labor, material, and equipment required for testing. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying the tests. Prior to performing hydrostatic tests, (see below), all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water at a sufficient flow rate and period to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory cleaning and flushing of the lines shall be subject to approval by the SDR.
 - 1. For test, the contractor shall provide a calibrated 4 inch diameter pressure gauge of maximum 1% full scale accuracy, maximum 200 PSIG range and maximum 2 PSIG graduations.
- B. Water System: Upon completion of the roughing-in and before setting fixtures, the entire hot and cold water piping systems installed under this contract shall be hydrostatically tested at a pressure of not less than 125 psig for 2 hours and proved tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be hydrostatically tested separately in the same manner as prescribed for the entire system.
- C. Sanitary System: The sanitary soil, waste and vent piping installed under this contract shall be tested by plugging all outlets and filling the lines with water to the level of the highest vent stack above the roof. The system shall hold this water for one hour without showing a drop greater than 3". Where only a segment of the system is to be tested, the test shall be conducted in the same manner as prescribed for the entire system, except that a vertical stack 10 feet (or height as recommended by the UPC) above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The Contractor if needed to isolate portions of the system for testing purposes shall install suitable fittings, such as plugged tees. The pressure shall be maintained for one hour. All joints shall be inspected for visible leaks. All soil or waste piping located underground shall be tested before backfilling.
- D. Final Plumbing Fixture Test: Upon installation of the plumbing fixtures, appurtenances or appliances having water and/or waste connections, and prior to the general use thereof, all water and waste connections shall have been proved tight, without defects or leaks by such operating tests as directed by the SDR.

3.06 DISINFECTION

Potable water piping installed under this contract shall be disinfected before it is placed in operation. Piping shall be disinfected after testing and flushing is performed per section 3.05A.

A. SNL Performed Work

1. Quality Testing: SNL will perform water quality Water testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality. SNL will approve use of disinfected piping when test results demonstrate compliance with water quality requirements of the Safe Drinking Water Act.
2. Notify the Sandia Delegated Representative (SDR) at least 48 hours (2 days) in advance to arrange for a bacterial quality or free total chlorine concentration test.
3. Requirements for demonstration of compliance with the Maximum Containment Level (MCL) of the Safe Drinking Water Act:
 - a. Total chlorine concentration of less than 1 mg/L (1ppm).
 - b. The absence of any coliform bacteria.
 - c. Less than 200 non-coliform bacteria per 100 mL.

B. Chlorination of Piping:

1. Inject sodium hypochlorite solution (bleach) containing 5-6 percent available chlorine, or 50,000 to 60,000 ppm into down stream of the main valve with a high pressure, low volume metering pump while the water is flowing at a given flow rate. After a chlorine residual of 25 ppm minimum is detected at each faucet of fixture (using a high-range chlorine test kit) the chlorine is allowed to remain in the pipes for at least 24 hours.
2. At the end of 24-hour period, treated water in all portions of piping shall have a free chlorine concentration of not less than 10 ppm. If the chlorine residual is less than 10 ppm, repeat the entire procedure. After residual free chlorine concentration test has been completed, flush the entire system with potable water until total chlorine concentration at all faucets and fixtures is less than 1 ppm.
3. Heavily contaminated water shall be disposed of or neutralized under the direction of SNL Pollution Prevention and Environmental Monitoring Department.
4. After flushing, contact the Sandia Delegated Representative (SDR) to arrange for final total chlorine concentration and bacteriological quality test.

C. Repairing or Cutting into Existing Mains:

1. New interior piping surfaces shall be swabbed with a 1% hypochlorite solution. The section being modified shall be subjected to a high chlorine disinfection process per AWWA C651, section 9. The concentration shall be a minimum of 300 mg/l for 15 minutes. At the end of the prescribed time period, flush affected piping with potable water until total chlorine concentration is less than 1 ppm.
2. After flushing, contact the Sandia Delegated Representative (SDR) to arrange for final total chlorine concentration and bacteriological quality tests. In order to minimize water service downtime; distribution lines that have been wholly or partially dewatered, hydrostatically tested, treated with chlorine, and sampled for bacteria, may be returned to service prior to the results of the bacteriological testing.

END OF SECTION