FACILITIES MANAGEMENT AND OPERATIONS CENTER

FMOC

Specification Section 15401 Plumbing

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Revision 1

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This document has undergone formal review and approval and been reviewed by a Derivative Classifier, and its contents have been deemed unclassified/unlimited release.

Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

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Change Log

Rev	By	Date	Type	Change Description	Pages Changed
0	KB DTS	08/11/10		Applied FMOC format and brand. Edited for grammar, punctuation, and general writing improvements. The addition of free standing drinking fountain specification language. Chapter 2.06 F 2 Additional specification language has been added to the wall mounted drinking fountain requirements. Chapter 2.06 F 1.	All
1	SM/RM/DV/ LEO	10/16/12		Applied new FMOC standard specification cover page, edited for grammar, and incorporated revisions from Shaun Martin in sections 1.02 part C, 1.03 part C, 2.05 part A, B, C, D, E, and F, and 2.06 part A. Incorporated revisions from Russel Matheson in section 1.04D and Part 2B.	Various

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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 installation of interior plumbing systems. Systems covered by this document are: domestic hot and cold water, nonpotable 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 used for modifications or additions must be the same material (such as copper or galvanized steel) as the existing systems being modified, and must 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 (SNL) Standard Specifications

Number	Title
Section 01300	Submittals
Section 02200	Earthwork
Section 09900	Painting
Section 15050	Basic Mechanical Materials and Methods
Section 15083	Piping and Equipment Insulation

B. American Society of Mechanical Engineers (ASME)

Number	Title
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

Number	Title
B16.12	Cast Iron Threaded Drainage Fittings
B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.23	Cast Copper Alloy Solder Joint Drainage 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)

- Z21.10.3 Gas Water Heaters - Volume III, Storage Water Heaters With Input Ratings Above 75,000 British thermal unit (BTU), per hour Circulating and Instantaneous

- Z358.1 Emergency Eyewash and Shower Equipment

D. American Society for Testing and Materials (ASTM)

Number	Title
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 Polyvinylidene Fluoride (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

E. American Waterworks Association (AWWA)

- AWWA C651 Disinfecting Water Mains

F. American Welding Society (AWS)

- A5.8 Specification for Brazing Filler Metal

G. Cast Iron Soil Pipe Institute (CISPI)

- 301 Cast Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems

H. International Underwriters Laboratories, Inc. (UL)

I. International Code Council

- International Plumbing Code® (IPC)

J. Americans With Disability Act (ADA) – Title 28 Code of Federal Regulations (CFR) Part 36 – ADA Standards for Accessible Design

1.03 Submittals

A. General

Submittals must be per SNL Construction Standard Specification Section 01330, *Submittal Procedures*. Where specific manufacturer or model numbers are mentioned in these specifications, proposed substitutions must be included in the submittal package.

B. Submittal Data Required

1. Pipe materials, valves, equipment, and accessories not listed in this specification under Part 2, *Products* must be submitted for approval.
2. Relief valves require submittals for approval.
3. Backflow preventers require submittals for approval.
4. All certifications for Welders, Brazers, and Fusion-Welded-Plastic-Pipe-Installers must be submitted to the Sandia Delegated Representative (SDR) for verification of quality assurance requirement SNL 15401, *Plumbing Specification* before starting work.

C. Sustainability Submittal Data

1. Water Efficiency: Submit manufacturer's product data indicating flush and flow rates for each plumbing fixture.
2. Energy Efficiency: Submit manufacturer's product data indicating Thermal Efficiency for all domestic water heater units.

1.04 Quality Assurance

A. Welding Materials

Welding materials must conform to ASME code for Pressure Piping, and ASME B31.3, *Process Piping*.

B. Welding, Brazing or Soldering:

1. Welders shall be certified in accordance with ASME Boiler and Pressure Vessel Code, as modified by ASME B31.3, *Process Piping*.
2. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME B31.3, *Process Piping*, for shop and jobsite brazing of piping work.
3. Qualify welding/brazing processes and welder/brazer performance in accordance with AWS B2.2, *Standard for Brazing Procedure and Performance Qualification*, or ASME Boiler and Pressure Vessel Code, Section IX. Certify that each welder/brazer has satisfactorily passed AWS or an ASME qualification test for the welding/brazing processes involved and if pertinent, has undergone recertification.
4. Certification of procedures and operators applies for both shop and jobsite welding and brazing of pipe work.
5. Performance qualification of welders/brazers must remain in effect indefinitely unless the welder/brazer does not weld or braze with the qualified procedure for a period exceeding 12 months, or if there is a specific reason to question the ability of the welder/brazer.
6. Welder/brazers must comply with SNL Construction Specification 01065, *ES&H for Construction and Service Contracts,* section 1.05E Hot Work Permit.
7. Soldering: Conform to ASME B31.3, *Process Piping and Copper Development Association* recommended practices.

C. Laboratory, Process, Acid Waste, and Vent-Piping Installers

1. Must be product-manufacturer-representative certified for the specific product/piping being installed.

D. Copper or Bronze Pressure Sealed Joints

1. Installers of Copper or Bronze Pressure-Sealed Joints: Pipefitters must be certified by the pressure-joint fitting manufacturer as having been trained and qualified to join copper pipe with pressure-seal fittings.

2. Copper pressure-seal fittings must be installed using the proper tool, actuator, jaws, and rings as instructed by the press-fitting manufacturer.

Part 2 - Products

2.01 Acceptable Manufacturers

The following products and materials must 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 must be lead-free per Public Law 99-339, *Safe Drinking 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, Nonpotable Water, and Pressure Drain Piping

1. Above Grade: Piping must 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.

Copper or Bronze Pressure-Seal Fittings: Copper or bronze housing, factory-installed Ethylene Propylene Diene Terpolymer sealing element, 200 pounds per square inch (psi) working pressure with a 0 to 250°F temperature rating. ASME B16.18 and B16:22, ASTM B88, and D 2000. Rigid ProPress™, or Stadler-Viega, or NIBCO® INC.

   a. 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 must be used. When piping is installed within a building and within or under a concrete slab, it must be installed without joints. Where joints are unavoidable, they must be brazed.

   a. Protective pipe covering must be factory- or field-applied according to manufacturer's written instructions.

      2½ Inches and Larger: Products must be Polyken® No. 1027 primer and Polyken No. 930-35 tape coating, 35 mil, 21kV dielectric strength, as manufactured by Tyco adhesives, Corrosion Protection Group. Minimum one-inch overlap required.

      2 Inches and Smaller: Products must be 27 MIL plastic sleeve-protector. LSP® Products Group, Plasti-Sleeve or equivalent.

C. Soil, Waste, Drain, and Vent Piping: Cast iron soil pipe, fittings, and connections must comply with CISPI guidelines.

1. Below Grade: Piping must be service weight hub and spigot (with gasket) coated cast iron and must conform to ASTM A74.

2. Above Grade: Piping must be Schedule 40, galvanized steel pipe, ASTM A53, with threaded, galvanized cast iron Durham drainage fittings, ANSI B16.12; or drain-waste-vent (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 must be flame retardant Schedule 40 Polypropylene (Georg Fischer "Fuseal II" PPFR Group 1 63153, or Enfield "Enfusion" Type II-37206), or PVDF (Fuseal 25/50 PVDF), or Spears® Labwaste™ chlorinated polyvinyl (CPVC). Polypropylene pipe must conform to ASTM F1412 and ASTM D4101. The PVDF pipe must conform to ASTM F1673, ASTM E84, and ASTM D3222. Joints and fittings must be DWV electric fusion and made of the same material as the piping. From neutralizing tank to sewer main: Pipe and fittings must be per Soil, Waste Drain and Vent Piping above.
2. Connection to equipment and fixtures in accessible locations must be made with mechanical joints.
3. Connection to existing systems of different materials must be made with the appropriate adapter provided by the contractor.

E. Roof Drain Leaders:

1. Below Grade: Leaders must be service weight hub and spigot coated cast iron and must 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:

1. Piping must 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. 2 Inches 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. 2½ Inches and Larger: Class 125, flanged ends, outside stem and yoke, 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, two-piece, threaded or soldered ends. NIBCO T-585-70 or S-585-70, or a three-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, unibody design, full ported, blow-out proof captive stainless steel stem and ball, and 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, ductile 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, ductile 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.
    a. 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.
    b. Needle: 1 Inch and Smaller: Rated at 600 psi and 300°F, positive shut-off for gauges, brass. Weiss Instruments 25 Needle Valve Brass or equivalent.

F. Strainers, Flanges and Unions

1. Strainers
    a. 2 Inches and Smaller: Threaded ends, cast bronze body with screwed cap, and 20-mesh 304 stainless steel screen for water service. Watts series 777S.
    b. 2½ Inches and Larger: Flanged ends, cast iron body and bolted cap, 20-mesh stainless steel screen for water service. Watts series 77-DI-125.
2. Flanges
    a. 1-½Inches and Smaller: Class 150, forged steel, screwed, ANSI B16.5
    b. 2 Inches and Larger: Class 150, forged steel welding neck, ANSI B16.5
    c. Copper Systems: Class 150, Cast Copper or Bronze, ANSI B16.23 or ANSI 16.24
3. Unions

a. Piping unions must 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 must be the same as the fittings used in the lines with the unions.

b. Steel unions must have hardened stainless steel seating surfaces on both faces.

c. 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.

d. Dielectric unions must not be used to join two dissimilar materials (ferrous and non-ferrous metallic). Use Brass fittings, valves, or unions to join dissimilar materials.

2.04 Cleanouts

A. Floor Cleanout:

a. 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:

a. Coated cast iron body with Acrylonitrile-Butadiene-Styrene plug and smooth stainless steel access cover. Zurn Z-1441 or Z-1445.

C. Acid Resistant Cleanouts:

a. Cleanouts for acid-resistant waste lines must be of the same material as the connecting waste pipes or approved equal.

2.05 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 must be white and furnished with all trim and accessories required for a complete installation. Fixtures must be provided with stop valves on both hot and cold water supplies. Metal trimmings on fixtures and exposed piping to fixtures, unless otherwise noted, must be chromium plated with chromium-plated escutcheons. Toilets and lavatories must be mounted on approved carriers or as indicated on the drawings.

Flushometer valves must be sensor operated when called out on drawings as such and must be manufactured by Sloan® or Zurn. No battery powered, sensor operated fixtures allowed. No substitutions allowed. If different manufactures are specified on the contract drawings, an equivalent Sloan or Zurn must be supplied.

A. Toilets

1. Floor Mounted, Tank Type: American Standard elongated "Cadet3 FloWise", 2835.128 (18" high) or 2832.128 (14" high) elongated bowl, 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 Optima # 111-ES-S sensor operated flush valve or Sloan Royal #111 flush valve or Zurn ZESS-6000XL-WS1 sensor operated flush valve or Zurn Z-6000XL-WS1 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 Optima #111-ES-S sensor operated flush valve or Sloan Royal #111 flush valve or Zurn ZESS-6000XL-WS1 sensor operated flush valve or Zurn Z-6000XL-WS1 and Olsonite #95 white open front seat.

B. Urinal

American Standard "WASHBROOK® FloWise®", No. 6590.001, 0.125 gallons per flush (GPF) application, wall hung and approved wall hanger with Sloan ECOS® 186-0.13 HW (0.125 GPF) sensor operated flush valve or Sloan Royal Model 186-0.125 (0.125 GPF) manual operated flush valve or Zurn ZEMS6003AV-ULF-IS (0.125 GPF) sensor operated flush valve, or Zurn Z6003AV-ULF (0.125 GPF) manual operated flush valve.

NOTE: Retrofitting urinals requires both flush valve and fixture to be rated for 0.125 GPF. Replacing an existing 1.0 GPF flush valve with a 0.125 GPF flush valve without also replacing the fixture is prohibited.

C. Lavatories

1. Kohler "Farmington", No. K2905-4, in-counter mount self rimming, white enameled cast iron oval bowl, 4-inch faucet centers.
2. Kohler "Hudson", No. K2861, wall-mount, white enameled cast iron bowl, 4-inch faucet centers.

D. Lavatory Faucets

1. Manual: Chicago Faucets No. 802-VE2805-317CP, 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 0.5 gallons per minute (GPM) non-aerating spray.
2. Automatic, when specifically called out for on drawings: Sloan Faucet No. ETF-80-4-P-BDM, 4-inch center electronic lavatory faucet, ADA-compliant, sensor activated, 24 volts alternating current, chrome plated cast brass, 0.5 GPM vandal resistant spray head, plug-in transformer, below deck manual mixing valve.

E. Kitchen/Pantry/Bar Faucets

1. Kitchen-type faucets installed in bathrooms, lunch rooms, break rooms, or pantry areas shall not exceed 1.5 GPM.

F. Showerheads

1. Showerheads shall comply with flow rate criteria established by the U.S. Environmental Protection Agency's WaterSense® program, 2.0 GPM.

G. Service Sink

1. 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.

H. 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, nonfreeze, anti-siphon, automatic draining, polished bronze face, ¾" hose connection, and operating key.

I. Drinking Fountains, Electric

1. Wall-Mounted: New drinking fountains must be barrier-free. Haws Model No. HWCA8. Wall mounted, steel with baked enamel finish, unit to provide 50° F water at 7.5 gallons per hour (GPH) at 80°F inlet and a 90°F ambient, R134A refrigerant, 115/60/1 provided with 3-wire grounding type cord and plug, UL listed.
2. Free Standing: Halsey Taylor® Model No. SCWT8A-CB-Q. Free-standing, standard platinum vinyl finish, unit to provide 50°F water at 7.6 GPH at 80°F inlet and a 90°F ambient, R134A refrigerant, 115/60/1 provided with a 3-wire grounding type cord and plug, UL listed.

J. 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" iron pipe size (IPS) stay-open ball valve. Eyewash valve to be ¾" IPS stay open hand operated ball valve. Units must 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 ¾" IPS stay open hand operated ball valve. Units must meet ANSI Z358.1.

2.06 Equipment

Equipment required for installation on this contract must be as specified and as shown on the applicable contract drawings and must 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 must be commercial grade, stock catalog item of standard manufacturer, glass lined, and unconditionally guaranteed for a minimum of 10 years. Insulation must be fiberglass with minimum R-value of 5. Tank must be nameplate rated for 127.5 psig (minimum working pressure) and must be constructed. For input ratings 200,000 BTUH and above certified and stamped to meet ASME Boiler and Pressure Vessel Code.

2. Domestic water heaters shall meet the U.S. Department of Energy Federal Energy Management Program designated products performance requirements.

    a. Gas, storage-type units with input ratings of 75,000 BTUH or above shall have a Thermal Efficiency greater than or equal to 94-percent, as measured by the thermal efficiency test procedure in ANSI Z21.10.3.

3. Manufacturer's ASME Data Sheets must be submitted per SNL Construction Specification 01330, *Submittal Procedure*.

4. Dip tubes, hot and cold water supply nipples, and baffles or heat traps used in the tank must be made to withstand a temperature of 400°F without deteriorating in any manner.

5. Gas burners must be of the high-recovery type and American Gas Association and UL listed. Electric water heaters must be UL listed.

6. Water heaters must 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 must be constructed, certified, and stamped to meet ASME Boiler and Pressure Vessel Code. Tanks must be glass-lined and have a thermometer and thermometer well installed at the points where the water enters and leaves the tank.

2. Tanks 80 gallons and larger must have a 12" x 16" manhole.

3. Tanks, regardless of size, must be provided with an ASME combination temperature and pressure relief valve with test lever.

4. Manufacturer's ASME Data Sheets must be submitted for approval and record keeping according to SNL Construction Specification 01330, *Submittal Procedure Product Data*.

C. Temperature and Pressure Relief Valves

1. All temperature and pressure relief valves must be in compliance with IPC.

2. Relief valves must be factory set, ASME listed, certified, and stamped.

3. Relief valves must be sized to relieve the unregulated capacity of the Pressure Regulating Valve , burner, or heating element.

Part 3 - Execution

3.01 Plumbing Installation

A. Contamination Prevention

1. Pipe interiors must be kept free of debris.

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

B. General

1. Plumbing accommodations in government facilities must 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 must conform to the IPC and this specification.
3. Plumbing installation must 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 must govern. Installed piping must not interfere with the operation or accessibility of doors or windows; must not encroach on aisles, passageways, and equipment; and must not interfere with the servicing or maintenance of equipment. Pipe must be cut accurately to measurements established at the construction site and must be worked into place without springing or forcing, properly clearing all openings and equipment. Pipe must not be bent. Cutting or weakening of structural members to facilitate piping installation is not permitted.
4. Plumbing installation must maintain the working spaces around electrical equipment as required by National Electric Code® section 110.26 F1, "Spaces About Electrical Equipment." Replacement of existing metal water piping must not occur without first ascertaining how the electrical ground system is configured.
5. Pipes must have burrs removed by reaming and must be installed to permit free expansion and contraction without damage to joints or hangers. Piping above ground must be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping must pitch down in the direction of flow with grade of not less than 1" in 40 feet. Piping connections to equipment must be in accordance with details shown on the drawings. Service pipe, valves, and fittings must be kept a sufficient distance from other work to permit finished surface not less than 1" from such other work.
6. Protect chrome or special finishes. Do not install such with abrasive tools.

C. Reducers

1. Reduction in pipe sizes must 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 or Flanges

1. Unions or flanges must be installed whenever threaded connections are used on equipment, instruments, or relief valve discharge lines.

E. Installation of Valves

1. Valves must be installed at the locations shown on the drawings and where specified. All valves must be installed with their stems between the horizontal and the 90° vertical. 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, must be rigidly supported from the building structure by means of adjustable ring-type, clevis-type, or band-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 must be as follows:

Steel Piping	Maximum Spacing
⅜" and smaller	4'-0"
½" through 1"	7'-0"
1-¼" through 4"	10'-0"
5" and larger	12'-0"

Copper Piping	Maximum Spacing
⅜" and smaller	4'-0"
½" through 1 ¼"	6'-0"
1 ½ " and larger	10'-0"

Plastic Piping	Maximum Spacing
1" and smaller	3'-0"
1 ¼" and larger	4'-0"

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

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

Pipe	Rod Size
⅜" to 2" pipe	⅜" rod
2-½" to 3" pipe	½" rod
4" to 5" pipe	⅝" rod
6" pipe	3/4" rod
8" through 12"	⅞" rod
14" through 16"	1" rod

3. Rods for trapeze hangers must be a minimum of ⅜" and must have the equivalent cross section listed above for each pipe supported. The use of pipe hooks, chains, perforated iron strapping or wire for pipe supports **will not** be permitted.
4. Hanger rods must be galvanized carbon steel per ASTM A307, Grade B, threaded per ANSI B1.1 coarse thread series, Class 2A fit. Hanger rods must 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 must be installed vertically. No offset in hanger rods are permitted.
7. Use hangers that are vertically adjustable between 1-½" minimum and 2" maximum after piping is erected.
8. Use copper straps on copper pipe and ferrous hangers on ferrous pipe.
9. Soft copper tubing, where permitted, must 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 and all flanged items.
12. "C" clamp style hanger must only be installed with retaining clip.

G. Joints

1. Cast iron pipe joints must be made in accordance with the IPC.
   a. Compression joints for bell and spigot pipe must have flexible, compression factory-fabricated joints composed of a neoprene gasketing system in accordance with IPC.
   b. Hubless joints must conform to standard specification 301 of the CISPI in above ground systems.
2. Flanged Joints
   a. All flanged joints must be face matched. Raised-face flanges must not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be machined flush. All flange bolt holes must straddle the horizontal and vertical centerlines unless otherwise noted. Bolting must comply with ANSI/ASME B31.3, *Process Piping*.
   b. Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.
   c. When making final assembly of a bolted flange joint, the following steps must be performed:

Step	Action
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.

Step	Action
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 according to the cross bolting pattern of the flange type, (2) stress to about 60%, tightening each bolt one after the another according to the cross bolting pattern of the flange type, (3) tighten to 100%, tightening each bolt one after the another according to the cross bolting pattern of the flange type, and (4) perform final full pass at 100% torque in a clockwise direction on adjacent bolts

3. Screwed Joints

   Screwed pipe joints must have Pipe Threads, General Purpose (Inch), ASME B1.20.1. Burrs formed when cutting pipe must be removed by reaming. Care must be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. The joints must be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound. Use Teflon tape or pipe joint sealant on plastic screwed pipe, never both.

4. Brazed or 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 must be brazed.

   c. Brazed copper-to-copper joints must be made with a silver-brazing alloy conforming to AWS A5.8, BCuP-5 (15% silver). Joints must comply with ANSI/ASME B31.3 Process Piping.

   d. Brazed copper to brass, or copper to stainless steel joints must be made with a silver-brazing alloy conforming to AWS A5.8, BAg-5 (45% silver). Joints must comply with ANSI/ASME B31.3 Process Piping.

   e. All solder joints, for copper tubing, must conform to recommend practices of the Copper Development Association, and must be made with 95-5 tin-antimony solder with the following exception:

      Solder containing antimony must 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.

5. Spears Labwaste (CPVC) Joints

   a. Spears Labwaste must be solvent welded per manufacturer's written instructions.

H. Cross-Connection Control

1. A reduced pressure backflow prevention assembly (RPBFP) must be installed to prevent cross-connection contamination between potable water systems and nonpotable 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, must be protected by an approved vacuum breaker device.

3. Backflow prevention RPBFP assemblies must be approved by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR).
4. Backflow prevention assemblies used or installed under this contract must be tested by a "Certified Backflow Control Assembly Tester" who possesses a current (within three years from date of issuance) certificate that confirms successful completion of an approved (USC-FCCCHR or Colorado Environmental Training Center, Golden, Colorado) training course.
5. The contractor must perform an operational test on any new or relocated backflow prevention assemblies used or installed under this contract. Passing backflow preventers must be labeled with a tag indicating test performed, tester's initials, and date. Testing documentation must be submitted per Specification 01330.
6. Repairs to backflow preventer (BFPs) must be made with original manufacturer's parts.
7. Piping downstream of BFPs must be labeled "Nonpotable" or "NPW" in accordance with Section 15050, *Basic Mechanical Materials and Methods*.
8. RPBFP devices must be installed at a maximum distance of five feet from finished floor with a one foot clearance maintained on all sides for ease of maintenance.
9. Adequate drainage must be provided for the RPBFP and must meet the following:
    a. Discharge must be piped full size (of the relief valve) and extend to a drain.
    b. Discharge piping must be sloped a minimum of ⅛" per foot.

I. Drains

1. Drains indicated on the drawings in connection with water distribution systems must be ¾" hose bib with integral vacuum breaker, unless otherwise noted.

J. Equipment Connections

1. All piping connections to pumps and other equipment must be installed without strain at the pipe connection of the equipment.
    a. The contractor must, as directed by the SDR, remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected.
2. Pipe connections to equipment must be made with unions, flanged fittings or grooved couplings.
3. Eccentric reducers are required at pumps and other equipment for air removal.
4. Install water heaters per IPC.

K. Water Hammer Arrestors

1. Sizes and locations of water hammer arrestors must be as indicated on the drawings and must be installed in an easily accessible location.

L. Joining Dissimilar Materials (Copper to Steel)

1. Use brass nipples, brass valves, or brass unions between copper and steel piping 2" and smaller. Use dielectric flanges on larger piping. Dielectric unions must not be installed between dissimilar materials.

M. Insulation

a. Insulation of all pipes, valves, fittings, and equipment must be in accordance with Section 15083, *Pipe and Equipment Insulation*, unless noted otherwise on the drawings.

N. Identification and Labels

1. All plumbing systems must be labeled and identified in accordance with Section 15050, *Basic Mechanical Materials and Methods*.

O. Chlorine Injection Port

1. A 3-way ball valve or an approved cleanout port must 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 must be piped full size and extended to a floor sink or to the outside of the building. Potable water lines must be either turned down towards the ground and terminated 6" above the ground, or piped to a drain. Piping must not have any trapped sections and must be sloped ⅛" per foot.
2. No valves of any type must 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

1. Must be provided at wall, ceiling, and floor penetrations of piping in occupied areas.

R. Access doors

1. Must 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. Soil, Waste, and Vent Piping

1. Must be installed in accordance with the IPC.
2. All excavation and backfill must be in accordance with 02200, *Earthwork*.

3.03 Polypropylene and PVDF Piping Installation

A. General

1. Fusion and mechanical joints must be installed by manufacturer certified experienced pipe fitters and as according to the manufacturer's instructions. The contractor must provide all tools and equipment necessary for proper installation. The contractor must provide for supports and thermal expansion to meet the manufacturer's recommendations.

B. Horizontal Piping

1. Support horizontal piping at end of branches and at change of direction or elevation. Clamp piping to control thermal expansion according to manufacturer's installation instructions.

C. Vertical Piping

1. Support risers with standard riser clamp or wall brackets.

D. Air Plenums

1. Piping installed in air plenums must be installed with piping materials that have a flame/smoke rating of 25/50 or less per ASTM E84 or piping must 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:

1. All fixtures and equipment must be installed complete with all accessories and trim required for proper installation.

B. Fixtures:

1. Fixtures must be firmly bolted to wall, floors, or carriers in accordance with the manufacturer's roughing-in and setting requirements and drawings. The contractor must make proper provision for hanging and setting fixtures and accessories during building construction. Where "rough-in only" is specified, rough-in must include stop valves on all service lines and waste line must be capped, ready for installation of trap by others. All fixtures must be installed square with the wall, in line, and level to provide a workmanlike and uniform appearance.

C. Equipment

1. Equipment must be installed in accordance with the manufacturer's directions and must be supported and fastened in a satisfactory manner.

D. Traps

1. Each fixture and piece of equipment connecting to the drainage system must be equipped with a trap. Each trap must be placed as near to the fixture as possible and there must be no double-trapped fixtures.

3.05 Tests

A. General

1. All plumbing, piping, equipment, and fixtures installed under this contract must be inspected and tested by the contractor before insulation is installed, in the presence of the Sandia Construction Observer (SCO), and approved before acceptance. The contractor must furnish all labor, material, and equipment required for testing. The contractor must 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 must be removed from the line or blanked off before applying the tests. Prior to performing hydrostatic tests, (see below), all lines must be "blown" free of all loose dirt and foreign particles. The lines must then be thoroughly flushed with potable 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 must be subject to approval by the SCO.

a. For test, the contractor must 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

1. Upon completion of the roughing-in and before setting fixtures, the entire hot and cold water piping systems installed under this contract must be hydrostatically tested at a pressure of no less than 125 psig and must show no drop in pressure in a two-hour period. Where a portion of the water piping system is to be concealed before completion, this portion must be hydrostatically tested separately in the same manner as prescribed for the entire system.

C. Sanitary System

1. The sanitary soil, waste and vent piping installed under this contract must 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 must hold this water for one hour without showing a drop in level. Where only a segment of the system is to be tested, the test must be conducted in the same manner as prescribed for the entire system except that a vertical stack supplying at least 10 foot head of water pressure must be installed above the highest horizontal line to be tested. The contractor must install suitable fittings, such as plugged tees, if such fittings are required to isolate portions of the system for the test. The segment of the system being tested must hold this water pressure for one hour without showing a drop in level. All joints must be inspected for visible leaks and all leaks must be repaired before the placing of the system into service. All soil or waste piping located underground must be tested before backfilling.

D. Final Plumbing Fixture Test

1. Upon installation of the plumbing fixtures, appurtenances or appliances having water and/or waste connections, and before the general use thereof, all water and waste connections must have been proved tight, without defects or leaks by such operating tests as directed by the SCO.

3.06 Disinfection

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

A. SNL-Performed Work

1. Quality Testing:

   a. SNL will perform water quality 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.

b. Notify the SDR at least 48 hours in advance to arrange for a bacterial quality or free total chlorine concentration test.

c. Requirements for demonstration of compliance with the Maximum Containment Level of the Safe Drinking Water Act:

(1) Total-chlorine-concentration of less than 1 milligram per liter (mg/L) (1 parts per million [ppm]).

(2) The absence of any coliform bacteria.

(3) 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 must have a free chlorine concentration of no 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. Dispose of or neutralize heavily contaminated water under the direction of SNL Pollution Prevention and Environmental Monitoring Department.
4. After flushing, contact the SDR to arrange for final total chlorine concentration and bacteriological quality test.

C. Repairing or Cutting into Existing Mains

1. New interior piping surfaces must be swabbed with a 1% hypochlorite solution. The section being modified must be subjected to a high chlorine disinfection process per AWWA C651, section 9. The concentration must 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 SCO to arrange for final total chlorine concentration and bacteriological quality tests. Water systems affected by chlorination may not be returned to service until test results have been reviewed and potability has been proven.