

CONSTRUCTION STANDARD SPECIFICATION

SECTION 15051

PIPING SYSTEMS

	<u>Page</u>
<u>PART 1 - GENERAL</u>	
1.01 Summary	2
1.02 Quality Assurance	2
1.03 References	3
1.04 Submittals	4
<u>PART 2 - PRODUCTS</u>	
2.01 Acceptable Manufacturers	5
2.02 Materials For Saturated Steam Systems	5
2.03 Materials For Space Heating, Chilled And Tower Water Systems (Including Water/Glycol Solutions)	7
2.04 Materials For Natural Gas Systems (Above ground).....	9
2.05 Materials For Compressed Air Systems (200 Psig And Under).....	10
2.06 Materials For Vacuum Systems	12
2.07 Equipment	13
<u>PART 3 - EXECUTION</u>	
3.01 Piping Installation	14
3.02 Tests	19

CONSTRUCTION STANDARD SPECIFICATION

SECTION 15051

PIPING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Materials and operations required for the installation of piping systems including: pipe fittings, valves, equipment, joints, and tests for the following systems:
 - 1. Steam
 - 2. Space Heating Water
 - 3. Chilled Water (including water/glycol solutions) and Tower Water
 - a. Aboveground
 - b. Belowground
 - 4. Natural Gas (For Below Ground Natural Gas Piping, see Section 02553, "Exterior Gas Piping Systems")
 - 5. Compressed Air
 - a. Aboveground
 - b. Belowground
 - 6. Vacuum
- B. Pipe and fittings to be used for modifications or additions shall be the same material (steel or copper) as the existing systems being modified, but shall conform to the following, unless otherwise indicated on the applicable contract drawings.

1.02 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ASME code for Pressure Piping, ANSI/ASME B31.1, Power Piping.

- B. Employ welders certified in accordance with ASME Boiler and Pressure Code, as modified by ANSI/ASME B31.1, Power Piping
- C. Brazing: Certify brazing procedures, brazers, and operators in accordance with ANSI/ASME B31.1, Power Piping, for shop and jobsite brazing of piping work.
- D. Soldering: Conform to ANSI/ASME B31.1, Power Piping.
- E. Natural Gas Piping and Equipment Installation: Contractor shall be licensed by the State of New Mexico Regulation and Licensing Department - Construction Industries Division, and shall use licensed pipefitters.

1.03 REFERENCES

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

- A. Sandia National Laboratories Standard Specifications:
 - 1. 01330 Submittal Procedures
 - 2. 02200 Earthwork
 - 3. 02553, Exterior Gas Piping Systems
 - 4. 09900 Painting
 - 5. 15050 General Material and Work Requirement - Mechanical
 - 6. 15200 Vibration Limits and Control
 - 7. 15083 Piping and Equipment Insulation
- B. American National Standards Institute (ANSI)
 - 1. ANSI B1.1 Unified Screw Threads
 - 2. ANSI B1.2 Gages and Gaging for Unified Inch Screw Thread
 - 3. ANSI B2.1 Standard Welding Procedure Specification
 - 4. ANSI B16.3 Malleable Iron Thread Fittings Classes 150 and 300
 - 5. ANSI B16.5 Pipe Flanges and Flanged Fittings
 - 6. ANSI B16.9 Factory-made Wrought Steel Buttwelding Fittings
 - 7. ANSI B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - 8. ANSI B16.24 Bronze Pipe Flanges and Flanged Fittings Class 150 and 300
 - 9. ANSI B31.1 Power Piping

- C. American Society of Mechanical Engineers (ASME)
ASME Boiler and Pressure Vessel Code
- D. American Society for Testing and Materials (ASTM)
 - 1. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - 2. ASTM A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 3. ASTM A182 Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service
 - 4. ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
 - 5. ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
 - 6. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - 7. ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - 8. ASTM B61 Standard Specification for Steam or Valve Bronze Casting
 - 9. ASTM B88 Seamless Copper Water Tube
- E. American Welding Society (AWS)
AWS A5.8 Specification for Brazing Filler Metal
- F. International Association of Plumbing and Mechanical Officials (IAPMO);
International Conference of Building Officials (ICBO)
 - 1. UMC Uniform Mechanical Code
 - 2. UPC Uniform Plumbing Code
- G. American Gas Association (AGA)

1.04 SUBMITTALS

- A. All required submittals shall be per Section 01330, "Submittal Procedures".
- B. All pipe materials, valves, equipment and accessories not listed in this specification under PART 2 - PRODUCTS shall be submitted for approval.
- C. All relief valves require submittals for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

The manufacturers listed under this section supply products of acceptable type, quality, and performance.

2.02 MATERIALS FOR SATURATED STEAM SYSTEMS

- A. Piping: Schedule 40 black steel with butt welded joints, ASTM A53, Grade B, Type S (seamless).
- B. Fittings:
 - 1. 1-1/2 Inches and Smaller: Screwed fittings, threaded tapered joints, ANSI B31.1, ANSI B2.1.
 - 2. 2 Inches and Larger: Schedule 40 wrought steel, ASTM A234, butt-weld, and ANSI B16.9.
- C. Flanges:
 - 1. 1-1/2 Inches and Smaller: 150 pound forged steel, screwed, ANSI B16.5.
 - 2. 2 Inches and Larger: 150 pound forged steel welding neck, ANSI B16.5.
- D. Gaskets: 0.175" thick with 1/8" solid-metal stay ring. Material is 304 stainless steel with chlorocarb graphite filler. Flexitallic, Style CG or Lamons Spiraseal Style WR.
- E. Bolts and Nuts: Bolts shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.
- F. Valves:
 - 1. Gate (30 to 125 psig service):
 - a. 1-1/2 Inches and Smaller: Class 150, inside screw, backseated union bonnet, rising stem, cast bronze construction per ASTM B61, solid wedge disc, with threaded ends. Crane No. 431UB.
 - b. 2 Inches and Larger: Class 150, cast steel, outside screw and yoke (OS&Y), rising stem, and flanged ends. Trim shall be bronze per ASTM B61 or 316 stainless steel. Nibco CS-102.
 - c. 4 Inches and Larger: Class 150, cast steel, OS&Y rising stem, flanged ends, bronze trim per ASTM B61, or 316 stainless steel. Nibco CS-102.
 - 2. Gate (under 30 psig):
 - a. 1-1/2 Inches and Smaller: Class 125, bronze body, threaded ends, rising stem, screwed bonnet and solid wedge disc. Crane No. 428.

- b. 2 to 3 Inches: Class 125, bronze body, threaded ends. Crane No. 428; Class 125, iron body OS&Y, flanged ends. Crane No. 465-1/2.
- c. 4 Inches and Larger: Class 125, iron body, flanged ends, OS&Y. Crane No. 465-1/2.

3. Globe:

- a. 1-1/2 Inches and Smaller: Class 150, bronze body, union bonnet, conforming with ASTM B61, tapered plug type, stainless steel disc and seat, threaded ends. Crane No. 14-1/2P.
- b. 2 Inches and Larger: Class 125, iron body conforming to ASTM A126, Class B, bronze trim, flanged ends, bolted bonnet, bronze disc, replaceable seats. Crane No. 351.

4. Check: 1-1/2 Inches and Smaller: Class 125, bronze, swing check, Y style bronze disc and screw caps, screwed ends. Crane No. 37.

5. Needle: 1 inch and smaller: positive shut-off for gages and manual air vents, brass. Whitey "O" Series.

G. Strainers:

- 1. 1-1/2 Inches and Smaller: Class 250, screwed ends, Y pattern with stainless steel screen - 20 mesh (0.033" openings). Spirax-Sarco Type "IT".
- 2. 2 Inches and Larger Y Style: Class 250, cast iron, flanged, with perforated stainless steel screen (2" to 3", 0.033" perforations for steam or water; 4" to 6", 0.045" perforations for steam, .125" perforations for water; 8" to 16", 0.062" perforations for steam, 0.125" perforations for water). Spirax-Sarco Type CI-125 or AF-250.
- 3. 2" to 12" Basket Strainer: Class 250, cast iron, flanged, quick-opening top access clamped cover, with perforated stainless steel basket strainer (2" to 3", 0.045" perforations for steam or water; 4" to 6", 0.045" perforations for steam, 0.125" perforations for water; 8" to 12", 0.062" perforations for steam, 0.125" perforations for water). Spirax-Sarco Type 528.

H. Traps:

- 1. Thermostatic, for saturated steam service: Angle, vertical or horizontal, brass or stainless steel body, screwed union type, stainless steel bellows, replaceable stainless steel seat. Spirax-Sarco Types TS-25, T-65 and T-125.
- 2. Float - Thermostatic, for saturated steam service: Class 200 iron body, all stainless steel interior components, screwed. Spirax-Sarco Types FT-10, FT-32 or FT-550 with ST-14 or ST-17 sensor chamber.
- 3. Thermodynamic, for saturated steam service: Class 300 stainless steel body, hardened stainless steel working surfaces, with integral 20 mesh stainless steel screen and 1/4" blow down valve, screwed. Spirax-Sarco TD-S-52 or TD-42 with ST-17 sensor chamber.

2.03 MATERIALS FOR SPACE HEATING, CHILLED AND TOWER WATER SYSTEMS
(INCLUDING WATER/GLYCOL SOLUTIONS)

A. Piping:

1. Aboveground:

- a. 2 Inches and Smaller: Schedule 40 black steel, welded (Type E) or seamless (Type S), ASTM A53, Grade A or B, or Type L hard drawn copper tubing, ASTM B88.
- b. 2-1/2 Inches and Larger: Schedule 40 black steel, welded (Type E) or seamless (Type S), ASTM A53, Grades A or B.

2. Underground: Schedule 40 black steel, seamless Type S or welded Type E, Grade A or B, ASTM A53.

- a. Joints: All joints in underground piping shall be welded, using Schedule 40 forged steel butt-weld fittings. All welding shall conform with the requirements of Standard Specification, Section 15050, "Basic Mechanical Materials and Methods". Use of unions underground is prohibited. Joints shall be wrapped with Scotchwrap No. 51 as manufactured by Minnesota Mining and Manufacturing Co.
- b. Protective pipe covering shall be mechanically applied in a factory or field plant especially equipped for the purpose.
- c. Special fittings which cannot be coated mechanically shall have the protective covering applied by hand. Hand-applied covering shall be equal in coating thickness and coating effectiveness to that of the mechanically applied covering. The pipe covering material shall be Scotchkote No. 101 pipe coating resin, as manufactured by Minnesota Mining and Manufacturing Co., or X-Tru Coat as manufactured by Standard Pipe Protection, Inc.

B. Fittings:

1. 2 Inches and Smaller: Class 150 banded malleable iron, screwed, ANSI B16.3; wrought copper and bronze solder-joint, ANSI B16.22; or Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.
2. 2-1/2 Inches and Larger: Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.

C. Flanges: Butt-weld or slip-on, full face.

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

D. Gaskets: 0.175" thick with 1/8" solid-metal stay ring. Material is 304 stainless steel with chlorocarb graphite filler. Flexitallic, Style CG or Lamons Spiraseal Style WR.

- E. Bolts and Nuts: Bolts shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.
- F. Valves:
 - 1. Gate:
 - a. 2 Inches and Smaller: Class 150, threaded ends, bronze body, rising stem, screwed bonnet, solid wedge disc. Crane No. 428.
 - b. 2-1/2 Inches and Larger: Class 150, flanged ends, OS&Y, iron body, bronze trim, rising stem inside thread. Crane No. 465-1/2.
 - 2. Ball:
 - a. 2 Inches and Smaller: Class 150, bronze body, blow-out proof captive stainless steel stem, double teflon seals and seats, full ported stainless steel ball. Nibco T-585, 2-piece, threaded ends; Nibco S-595-Y-66, 3-piece, swing-out body, solder ends.
 - b. 2-1/2 Inches and Larger: Class 150, flanged ends, carbon steel body with 316 stainless steel trim, blow-out proof captive stainless steel stem and ball, double teflon seals and seats. Nibco F510 Series.
 - 3. Globe:
 - a. 2 Inches and Smaller: Class 125, screwed ends, bronze body, inside screw, screw-in bonnet, renewable seat and disc. Nibco T-211.
 - b. 2-1/2 Inches and Larger: Class 125, iron body conforming to ASTM A126, Class B, bronze trim, flanged ends, bolted bonnet, bronze disc, replaceable seats. Crane No. 351.
 - 4. Plug:
 - a. 2 Inches and Smaller: Class 150, iron body, threaded ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Model 066.
 - b. 2-1/2 Inches and Larger: Class 150, iron body, flanged ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Models 067 or 067EG.
 - 5. Butterfly: 2-1/2 Inches and Larger: Class 200, iron body, aluminum/bronze disc, stainless steel shaft, resilient seat, O-ring seals, lug type for dead-end service, lever operator. Nibco LD 2000-5.
 - 6. Check, Swing:
 - a. 2 Inches and Smaller: Class 125, threaded ends, bronze body, Y pattern, screw cap. Crane No. 37.
 - b. 2-1/2 Inches and Larger: Class 150, flanged, bolted bonnet, B61-bronze trim or 316 stainless steel trim. Nibco F-938.

7. Check, Vertical: 2 Inches and Smaller: Class 125, threaded ends, bronze body, spring actuated, inline lift type, TFE seat ring. Nibco T-480-Y.
 8. Needle: 1 inch and smaller, positive shut-off for gages, brass. Whitey "O" Series.
- G. Strainers:
1. 2 Inches and Smaller: Threaded ends, cast iron body with screwed cap, 20 mesh monel screen for water service. Spirax-Sarco Type "IT".
 2. 2-1/2 Inches and Larger: Flanged ends, cast iron body and bolted cap, 20 mesh monel screen for water service. Spirax-Sarco Type CI-125.
- H. Flexible Connectors:
1. 2 Inches and Smaller: Threaded ends, corrugated inner tube and wire braid outer shield, Type 321 stainless steel. MetraFlex M/L or S/L.
 2. 2-1/2 Inches and Larger: Flanged ends, corrugated inner tube and wire braid outer shield, Type 321 stainless steel. MetraFlex M/L or S/L.
- I. Glycol-Resistant Materials: All materials installed in a system containing a water/glycol solution shall be resistant to (compatible with) glycol. Suitable materials include steel, iron, and bronze (red brass).

2.04 MATERIALS FOR NATURAL GAS SYSTEMS (Above ground)

- A. Piping: Schedule 40 black steel, seamless Type S or welded Type E, ASTM A53, Grade A or B.
- B. Fittings:
1. 2 Inches and Smaller: 150-pound banded malleable iron, screwed, ANSI B16.3.
 2. 2-1/2 Inches and Larger: 150-pound banded malleable iron, screwed, ANSI B16.3, or Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.
- C. Valves:
1. Plug: Class 150, iron body, flanged or threaded ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Models 066, 067, or 067EG.
 2. Needle: 1 inch and smaller, positive shut-off for gages, brass. Whitey "O" Series.
- D. Flexible Connectors: Stainless steel, corrugated, AGA certified for indoor and outdoor use. Dormont Manufacturing Co., SSC Series, N and NP.

2.05 MATERIALS FOR COMPRESSED AIR SYSTEMS (200 psig and under)

A. Piping:

1. Aboveground:

- a. 2 Inches and Smaller: Schedule 40 black steel, seamless Type S or welded Type E, Grade A or B, ASTM A53; or Type L hard-drawn copper tubing, ASTM B88.
- b. 2-1/2 Inches and Larger: Schedule 40 black steel, seamless Type S or welded Type E, Grade A or B, ASTM A53.

2. Underground: Schedule 40 black steel, seamless Type S or welded Type E, Grade A or B, ASTM A53.

- a. Joints: All joints in underground piping shall be welded, using Schedule 40 forged steel butt-weld fittings. All welding shall conform with the requirements of Standard Specification, Section 15050, "Basic Mechanical Materials and Methods". Use of unions underground is prohibited. Joints shall be wrapped with Scotchwrap No. 51 as manufactured by Minnesota Mining and Manufacturing Co.
- b. Protective pipe covering shall be mechanically applied in a factory or field plant especially equipped for the purpose.
- c. Special fittings which cannot be coated mechanically shall have the protective covering applied by hand. Hand-applied covering shall be the equal in coating thickness and coating effectiveness to that of the mechanically applied covering. The pipe covering material shall be Scotchkote No. 101 pipe coating resin, as manufactured by Minnesota Mining and Manufacturing Co., or X-Tru Coat as manufactured by Standard Pipe Protection, Inc.

B. Fittings:

1. 2 Inches and Smaller: Class 150 banded malleable iron, screwed, ANSI B16.3; Schedule 40 wrought steel butt-weld fittings, ANSI B16.9; or wrought copper and bronze braze-joint, ANSI B16.22, ASTM B88.
2. 2-1/2 Inches and Larger: Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.

C. Flanges:

1. Flanges 2 inches and smaller shall be Class 150 bronze flanges, ANSI B16.24, or Class 150 forged steel flanges conforming to ANSI B16.5.
2. Flanges 2-1/2 inches and larger shall use Class 150, forged steel flanges conforming to ANSI B16.5 limitations on bolting in 5.3, 6.4, and on gaskets in 5.4, and are properly aligned and assembled. See also 2.4, Temperature Considerations.

D. Gaskets:

1. For steel flanges: 0.175" thick with 1/8" solid-metal stay ring. Material is 304 stainless steel with chlorocarb graphite filler. Flexitallic Style CG or Lamons Spiraseal Style WR.
2. For bronze flanges: 0.175" thick with 1/8" solid-metal stay ring. Material is copper with chlorocarb graphite filler. Flexitallic Style CG or Lamons Spiraseal Style WR.

E. Bolts and Nuts: Bolts shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.

F. Flexible Connectors:

1. 2 Inches and Smaller: Threaded ends, corrugated inner tube and wire braid outer shield, Type 321 stainless steel. MetraFlex M/L or S/L.
2. 2-1/2 Inches and Larger: Flanged ends, corrugated inner tube and wire braid outer shield, Type 321 stainless steel. MetraFlex M/L or S/L.

G. Valves:

1. Gate:

- a. 2 inches and smaller: Class 150, threaded ends, bronze body, rising stem, union bonnet. Crane No. 431.
- b. 2-1/2 inches and larger: Class 150, flanged ends, iron body, bronze trim, bolted bonnet, rising stem. Nibco CS-102.

2. Globe:

- a. 2 Inches and Smaller: Class 150, threaded ends, bronze body, rising stem, union bonnet. Crane No. 7TF.
- b. 2-1/2 Inches and Larger: Class 150, flanged ends, cast steel, OS&Y, bolted bonnet. Nibco CS-132-U.

3. Plug: Class 150, iron body, flanged or threaded ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Fig. 066, 067 or 067EG.

4. Check Valves: Nupro Series C, CP. Series P used for manual purge of manual vent.

5. Ball:

- a. 2 Inches and Smaller: Class 150, bronze body, blow-out proof captive stainless steel stem, double teflon seals and seats, full ported stainless steel ball. Nibco T-585, 2-piece, threaded ends; Nibco S-595-Y-66, 3-piece, swing-out body, solder ends.

- b. 2-1/2 Inches and Larger: Class 150, flanged ends, carbon steel body with 316 stainless steel trim, blow-out proof captive stainless steel stem and ball, double teflon seals and seats. Nibco F510 Series.
6. Needle: 1 inch and smaller, positive shut-off for gages, brass. Whitey "O" Series.

2.06 MATERIALS FOR VACUUM SYSTEMS

A. Piping:

1. 2 Inches and Smaller: Schedule 40 black steel, seamless or welded, ASTM A53, or Type L hard-drawn copper tubing, ASTM B88, or Type 304 stainless steel.
2. 2-1/2 Inches and Larger: Schedule 40 black steel, seamless or welded, ASTM A53 or Type 304 stainless steel.

B. Fittings:

1. 2 Inches and Smaller: Class 150 banded malleable iron, screwed, ANSI B16.3; wrought copper and bronze solder-joint, ANSI B16.22; or Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.
2. 2-1/2 Inches and Larger: Schedule 40 wrought steel butt-weld fittings, ANSI B16.9.
3. 1/4" to 2" Tube Fittings: Carbon steel and 316 stainless steel. Swagelok.
4. 1/4" to 1" Weld Fittings: Carbon steel, 316 stainless steel. Cajon.

C. Flanges: Flanges shall conform to ANSI B16.5

D. Gaskets: 0.175" thick with 1/8" solid-metal stay ring. Material is 304 stainless steel with chlorocarb graphite filler. Flexitallic Style CG or Lamons Spiraseal Style WR.

E. Bolts and Nuts: Bolts shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.

F. Valves:

1. Plug:

- a. 2 Inches and Smaller: Class 150, iron body, threaded ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Model 066.
- b. 2-1/2 Inches and Larger: Class 150, iron body, flanged ends, resilient PTFE sleeve and tapered plug for tight shut-off, non-lubricated. Xomox Tuflin Models 067 or 067EG.

2. Ball: Vacuum service to Class 125.
 - a. 2 Inches and Smaller: Class 125, screwed or soldered ends, bronze body, O-ring seal swing-out body. Worchester Series 44.
 - b. 2-1/2 Inch and Larger: Class 125, flanged ends, bronze O-ring seal. Worchester Series 45.
3. Needle: 1 inch and smaller, positive shut-off for gages and manual air vents, brass. Whitey "O" Series.

2.07 EQUIPMENT

- A. General: Equipment required for installation on this contract shall be as specified on the applicable contract drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.
- B. Compressed Air Receivers:
 1. Receiver shall conform to the ASME Boiler and Pressure Vessel Code requirements for unfired pressure vessels including the following specific requirements:
 - a. Joint efficiencies, E, used in the design of the receiver shall be selected in accordance with UW-12(c).
 - b. Welded joints shall be examined radiographically for their full length in accordance with UW-51.
 2. Receiver shall be National Board registered and so stamped.
 3. Receiver shall be equipped with shut-off valve, ASME-rated pressure relief valve, automatic drain valve, manual-bypass drain valve, pressure gage with cock, pressure switch, and any other appurtenances required for satisfactory operation. Size and capacity shall be as listed on the drawings.
 4. Two copies of the manufacturer's data report shall be submitted to the Sandia Delegated Representative (SDR).
- C. Pressure Relief Valves: Valves shall be ASME stamped and National Code certified. The valves shall be factory set to maintain an operating or standby pressure as directed or noted.
- D. Thermometers and Thermowells: Thermometers shall be the molecular sieve, bourdon tube type, direct or remote mounted with a stainless steel case. Each thermometer shall be provided with a separable thermowell consisting of a 3/8" stainless steel bore, plug, and chain. The well shall be the length required for accurate reading of the thermometer. Where thermometers occur in the insulated piping systems, or on insulated equipment, extension necks shall be provided so that the thermometer casing will be outside of the insulation. Ashcroft Duratemp Type 600.

- E. Gages: Gages shall be safety-type with rear blowout plug or panel, clear plastic cover, and sides and front consisting of one integral part. Range shall be at least 1.2 times the system relief pressure. Gages shall be installed with snubbers and 1/4" bronze needle valves. All gages for steam systems shall be provided with siphon tubes and snubbers.
- F. Automatic Air Vents: Air vents shall be Spirax-Sarco Type 13W with brass bodies, all non-ferrous internals and 150 psi maximum operating pressure. Vents shall be capable of accepting 1/4" O.D. copper tubing.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. General: Piping installation shall be coordinated, with respect to space available, with heating, ventilating, and electrical installation. In every instance where there is a 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. Cutting or weakening of structural members to facilitate piping installation is not permitted. 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 inch in 40 feet. Service pipe, valves, and fittings shall be located a sufficient distance from other work to permit the installation of the finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between the finished covering on the different services.
- B. Reducers: Reduction in pipe sizes shall be made with one-piece reducing fittings. Forged bushings will be acceptable ONLY when there is no room for reducing couplings or swagged nipples and the reduction of at least two pipe sizes. Bushings shall not be used for fuel gas service. Only eccentric reducers will be permitted in steam applications. Cast bushings ARE NOT acceptable.
- C. Unions: All piping unions shall be of the ground joint type, constructed from materials equivalent in alloy composition and strength to other fittings specified 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. Dielectric unions shall be used to connect dissimilar metals (such as steel to copper) to prevent electrolytic action.
- D. 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 horizontal or above and with sufficient clearance to allow the inspection and repair of two-piece and three-piece valves in place. All screwed valves shall be installed with a down stream union.

E. Hangers and Anchors:

1. All piping 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:

a. Horizontal:

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

- b. Vertical: Steel and copper piping shall be supported at 10'-0" intervals, maximum.

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 inch and shall have the equivalent cross section, listed in 3.01.E.2, 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:
 - a. Hanger rods shall have minimum 6" threaded ends.
 - b. All hanger rod connections shall use double nut fastening.

5. Hanger rods shall be installed vertically. No offset in hanger rod will be permitted.
 6. Place a hanger within 1'-0" of each horizontal elbow.
 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 clamps and spaced not more than 4'-0" apart.
 10. On 4" and larger piping, install hangers adjacent (within 1'-0" on each side) to all horizontal elbows, strainers, check valves, valves, and all flanged items.
 11. "C" clamp style hanger shall only be installed with retaining clip.
- F. Piping Equipment Supports and Fastenings: Fixtures and equipment shall be solidly supported and securely fastened. Installation shall include suitable backing to anchor all hanging fixtures and equipment.
- G. Air Vents (For Closed Water and Water/Glycol Systems):
1. Manual: Where air vent locations are 8'-0" or more above the floor, 1/4-inch O.D. copper tubing shall be installed at the point of venting and extended down with the needle valve installed 7'-0" above the floor for easy access.
 2. Automatic Air Vents: Automatic air vents shall be size 1/2 inch, 150 psi maximum operating pressure. A manual shutoff valve shall be installed ahead of each automatic air vent. Body of brass, for use on hot or cold water, with threaded outlet for 1/4" O.D. copper tube. Do not install automatic vent valves in the glycol system.
 3. Each branch and main system high point shall be vented with a manual vent, after installation, as required to permit removal of all air from the system.
- H. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. 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. Pipe connections to equipment shall be made with unions or flanged fittings.
- I. Joints:
1. 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 bolt holes shall straddle the horizontal and vertical centerlines unless otherwise noted. Bolting shall comply with ANSI/ASME B31.1, Power Piping. Torque values and tightening sequence for bolts shall be in accordance with flange manufacturer's instructions.

Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.

The following procedure shall be followed when making final assembly of a bolted flange joint.

- a. Install the gasket on the gasket seating surface and bring the cover flange in contact with the gasket.
- b. Install all bolts, making sure they are free of dirt and grit, and are well lubricated.
- c. Run-up all nuts finger tight.
- d. Develop the required torque in each bolt in a minimum of four steps:
 - 1) The first sequence shall set the bolts at 30% of the required torque. Damage to the gasket can result beyond this amount for the first sequence.
 - 2) The second sequence shall set the bolts at 60% of the required torque.
 - 3) The third sequence shall set the bolts at 90% of the required torque.
 - 4) The fourth sequence shall set the bolts at 100% of the required torque. A final tightening should be performed in a clockwise bolt-to-bolt sequence to ensure that all bolts have been evenly stressed.

By following the above steps, a reasonably even compressive force can be exerted on the gasket. For low-pressure applications, exacting torque values for bolts are not required. Instead, it is much more important that each bolt is fairly evenly stressed.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B1.2. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Metal screwed pipe joints shall be made leak-tight by the use of Teflon tape and approved Teflon thread sealing and lubricating compound.
3. Nitrogen Purge: A dry nitrogen purge is required inside piping or tubing during brazing.
 - a. Purge manifold shall be fabricated to the same specification as the piping system.
 - b. For continuous runs of piping, brazing shall begin at the purge port area and continue through the system. The purge connection shall not be changed. Use purge restrictor at end of piping run. Stainless steel compression fittings with nylon ferrules can be used for temporary restriction on tees and tube ends.
 - c. Do not begin brazing until piping is fully purged of air.

- d. While brazing, the minimum purge rate shall be 15 SCFH for 1/4 inch piping, 25 SCFH for piping through 3/4 inch, and 35 SCFH for larger piping.
- e. Purge shall continue after completion of braze until joint is cool enough to touch with bare hands.

4. Brazed/Solder Joints:

- a. Cut tube ends square. Ream, remove burrs, and size.
- b. All joints, in compressed air service, greater than 60 psig or service temperatures (any media) greater than 200^oF, 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 B31.1 Power 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, BA_g-7 (45% silver). Joints shall comply with ANSI/ASME B31.1 Power Piping.
- e. All solder joints, for copper tubing, 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. Solder end valve: Use two-piece gate or globe valve or three-piece ball valve for solder end valves. When joining a gate or globe solder end valve, ensure valve is fully open. Apply heat to tube first. Transfer as much heat as possible through the tube to the valve. Avoid prolonged heating of valve. Use a non-corrosive paste flux and solid wire solder suitable for the service temperatures and pressures expected.
 - g. Use sand cloth or a steel wire brush to clean surfaces to be joined. Steel wool IS NOT permitted.
5. Welded Joints: All pipe surfaces shall be thoroughly cleaned before welding. Each joint, except socket-weld joints, shall be beveled before being welded. The Contractor shall provide an approved, non-asbestos mat or blanket to protect the structure and adequate fire protection equipment at all locations where welding is done. Welding sockets or weldolets may be used in lieu of reducing outlet tees for branch connections up to one-half the size of the main run. On connections larger than one-half the size of the main run, welding tees shall be used. The use of fittings formed from welded pipe sections IS NOT PERMITTED.

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

- K. Discharge from pressure relief valves shall be piped full-size and extended to the outside of the building structure, unless otherwise shown on the drawings.
- L. Insulation of all pipes, valves, fittings, and equipment shall be in accordance with Section 15083, "Piping and Equipment Insulation" unless noted otherwise on the drawings.
- M. Identification and Labels: All piping systems shall be labeled and identified in accordance with Standard Specification, Section 15050, "Basic Mechanical materials and Methods".
- N. Cross-Connection Prevention:
 - 1. A backflow prevention device approved by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR) and IAPMO shall be installed at all piping, equipment, and temporary fill connections that establish a cross-connection between a potable water system and a polluted or contaminated system such as a drainage system, ethylene glycol solution, or fire protection system.
 - 2. All hose bibbs shall be protected with an approved (USC-FCCCHR and IAPMO) integral vacuum breaker device.
 - 3. All piping downstream of any backflow prevention device shall be labeled "Non-Potable Water" or NPW in accordance with Standard Specification, Section 15050, "Basic Mechanical Materials and Methods".
 - 4. All backflow prevention devices installed under this contract shall be tested by a "Certified Backflow Assembly Tester" who possesses a current (within three (3) 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 shall provide testing of all backflow prevention devices installed under this contract and submit documentation of testing to the Sandia Delegated Representative (SDR).
- O. Compressed Air Receivers: Install receiver with sufficient clearance to allow access to manhole or armhole.

3.02 TESTS

A. General:

Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and pressure tested by the Contractor in the presence of the Sandia Delegated Representative (SDR) and approved before acceptance. All labor, material, and equipment required for testing shall be furnished by the Contractor. 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 tests, all lines shall be blown free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with

water (liquid lines only) or compressed air (for gas lines) at a sufficient flow rate and period of time to insure complete cleaning on the line of all dirt, scale, and foreign matter. Cleaning and flushing of the lines shall be subject to approval by the SDR. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Testing:

1. Steam, condensate, hot water, chilled water, and tower water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2-hour period.
2. Natural gas, compressed air, and vacuum piping shall be tested using compressed air or dry nitrogen, as indicated at the test pressures specified and shall show no drop in pressure in a 2-hour period; gas leaks shall be located by soap testing.

C. Test Pressures:

Unless otherwise specified, hydrostatic test pressure shall be 1.5 times the system operating pressure, pneumatic test pressure shall be 1.25 times system operating pressure, or as noted below.

<u>SYSTEM</u>	<u>TEST PRESSURE (psig)</u>	
	<u>Hydrostatic</u>	<u>Pneumatic</u>
Steam System (125 psig)	225	--
Steam System (30 psig & less)	50	--
Condensate System	100	--
Space Heating Water, Chilled Water, and Tower Water System	100	--
Natural Gas System	--	25
Compressed Air System	--	250
Vacuum System	--	100

END OF SECTION