SECTION15050
PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes fabrication and installation requirements for piping systems defined in Section 15545, 15455 and 15106.

B. Related sections include the following:
   1. Division 2, Section 02222 “Excavation for Utilities
   2. Division 15, Section 15052 “Brazing”
   3. Division 15, Section 15072 “Cleaning”
   4. Division 15, Section 15074 “Identification and Labeling”
   5. Division 18, Section 18100 “General Welding Requirements”

1.3 REFERENCES

A. American National Standards Institute (ANSI)
   1. ANSI B1.20.1-83, Pipe Threads, General Purpose (Inch) (R 1992)

B. American Society of Mechanical Engineers (ASME)
   1. ASME B31.3-99c, Chemical Plant and Petroleum Refinery Piping.
   2. ASME B31.9-96, Building Service Piping

C. American Society for Testing and Materials (ASTM)
   1. ASTM B32-94, Standard Specification for Solder Metal.
   2. ASTM B828-92, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube Fittings.

D. Copper Development Association (CDA)
   1. CDA 404/0R, Copper Tube Handbook, Copper Development Association, Inc.

E. Southern Building Code Congress International Incorporated
   1. Standard Plumbing Code (1997).

1.4 DEFINITIONS

A. Pressure-Relief Valve: pressure-relieving device designed to re-close after normal conditions have been restored to prevent further flow of fluid.

B. Safety Valve: pressure-relief valve actuated by inlet static pressure and characterized by rapid-opening/pop-action.

C. Relief Valve: pressure-relief valve actuated by inlet static pressure and characterized by opening in proportion to increases in inlet static pressure.

D. Safety-Relief Valve: pressure-relief valve characterized by rapid-opening/pop-action or by opening in proportion to increases in inlet static pressure, depending on application.

E. Non-closing Pressure-Relief Device: pressure-relieving device designed to remain open after operation (e.g., rupture discs, fuse plugs, etc.).

1.5 PERFORMANCE REQUIREMENTS

A. Acceptance of piping systems and associated equipment is contingent upon proper execution of specified tests and acceptable test results.

B. Acceptance of equipment is contingent upon equipment satisfactorily performing its specified function.

C. Construction Manager (CM) will prepare and issue acceptance reports for equipment and systems. Construction Manager will retain original acceptance reports.

D. Coordination Drawings: Project trades shall coordinate their relevant input with all project trades and resolve any and all interferences. Coordination drawings shall include floor plans and sections drawn to scale. These drawings shall show location of equipment, piping, ductwork, drains, controls and conduits with relation to components of other trades with dimensional reference to columns, floor slabs, beams or other suitable reference point. Close cooperation between the trades shall be required. Each affected trade shall certify by endorsement (sign and date) on these coordination drawings, that they represent an accurate record of work to be executed. One copy of the mechanical and electrical coordination drawings shall be sent to the Construction Manager in advance of procurement and installation of components.

E. Work installed without regard for other trade work shall be removed, if necessary, at the installing Subcontractor's expense.

1.6 SUBMITTALS FOR APPROVAL

A. Cold bending equipment, procedures, and methods.

B. Hot bending equipment, procedures, and methods.

C. Brazing procedures, methods and brazer qualification records.

1.7 SUBMITTALS FOR INFORMATION

A. Red-lined copies of design drawings that indicate changes made from routing shown on design drawings.

B. Test Reports for piping systems and associated equipment.

C. Acceptance Reports for equipment and systems (prepared by Construction Manager).

1.8 QUALITY ASSURANCE

A. Cold Bending Procedure Qualification.
   1. Bend three consecutive samples.
   2. Inspect samples to specification requirements.

3. Examine surface of samples for cracks and tears by liquid penetrant or magnetic particle method.
    a. Measure wall thickness directly by sectioning bend or by ultrasonic methods. Bend pipe so that minimum wall thickness is not less than that allowed by code requirements of material before bending.

B. Hot Bending Procedure Qualification
1. Bend three consecutive samples.
2. Inspect samples to specification requirements:
    a. Examine surface of samples for cracks and tears by liquid penetrant or magnetic particle method.
    b. Measure wall thickness directly by sectioning bend or by ultrasonic methods. Bend pipe so that minimum wall thickness is not less than that allowed by code requirements of material before bending.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and valves to site in clean and protected condition.

B. Maintain end seals and flange covers in place. Remove seals and covers only for cleaning,

C. Exercise care in handling and storage of materials and prefabrications to ensure that contamination by foreign material does not occur.

D. Reinstall end seals or covers on partially erected systems to prevent contamination by foreign material.

PART 2 - PRODUCT

2.1 FABRICATION

A. Code Requirements:
1. Fabricate piping systems specified in Division 15 per Normal Fluid Service requirements of ASME B31.9 except where otherwise specified.
2. Additional and alternate fabrication requirements are specified in individual system sections of these specifications.

B. Cutting
1. Cut pipe and tubing accurately with pipe or tube cutters.
2. Ream cuts to remove burrs.
3. Remove defects by machining, chipping, or grinding.

C. Cold Bending
1. Do not perform cold bending on piping without prior approval.
2. Make cold bends only in steel, aluminum, copper, or alloy pipe and tube. Cold bending is not permitted in lined pipe.
3. Re-qualify and approve change in process, equipment manufacturer, equipment model, pipe schedule, wall thickness, material specification type, specification grade, or a decrease in bend radius of cold bending.
4. Fabricate bends free from cracks, buckles, wrinkles, bulges, and grooves.
5. Locate weld seams as near as practical to neutral axis of bend. In compound bends, locate weld seam no closer than 30 degrees to inner or outer radius.
6. Bend pipe and tubing with 1/2-inch actual outside diameter and larger so that ovallity does not exceed 8% after bending. Calculate ovallity as follows:
    a. where:

1) Dmax = maximum diameter after bending,
2) Dmin = minimum diameter after bending,
3) D0 = minimum diameter before bending.

D. Hot Bending
1. Do not perform hot bending on piping without prior approval.
2. Re-qualify and approve change in process, equipment manufacturer, equipment model, pipe schedule, wall thickness, material specification type, specification grade, or a decrease in bend radius of cold bending.
3. Fabricate bends free from cracks, buckles, wrinkles, bulges, and grooves.
4. Fill tube or pipe to be bent completely and compactly with dry, sulphur-free, high-temperature silica sand of a suitable grade and fineness. Plug or cap ends of pipe or tube to confine sand. Heat section to be bent uniformly, bend to desired configuration, allow to cool, and remove sand. Reject sections having wrinkles, flats, or humps. Clean pipe after hot bending.
5. Off-Site Fabrication: Perform off-site fabrication in compliance with on-site fabrication requirements.

2.2 SOURCE QUALITY CONTROL

A. Shop-Fabricated Piping Tolerance: ±1/8-inch maximum on overall dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
1. Follow piping route shown on drawing. Record changes required to suit field conditions from routing or components shown on drawings.
2. When joining dissimilar materials, provide nonconducting dielectric connections.
3. Provide clearance for installation of insulation and access to valves, flanges, and unions.
4. Provide access where valves, flanges, and unions are not exposed.
5. Install piping to conserve building space and not interfere with use of space.
6. Group piping at common elevations.
7. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
8. Cold springing is only permissible when called for on the engineering drawings.
9. Provide piping connections to equipment with flanges or unions.
10. Paint piping where specified or shown.
11. Install specialties per manufacturer's instructions.
12. Asbestos gaskets and asbestos impregnated materials are not to be used.
13. Clean piping per Section 15072.
14. Label piping systems per Section 15074.

B. Underground Piping – Under Building Slabs and Foundations
1. Follow route shown on drawings for underground lines. Verify that excavations are to required grade, dry, and not over-excavated.
2. Maintain a 1-foot clearance between pipe surfaces at points where lines being installed cross existing lines.
3. Coordinate with Division 2, Site Work, Section 02667, “Water Lines”.
for concrete encasement requirements of potable water lines installed near: sanitary, chemical, radioactive liquid-waste lines, or other hazardous services. .
4. Trenching: Section 02222, Excavation for Utilities.

5. Clean ditch of debris and other foreign matter immediately before pipe is lowered into ditch. Where ditch is in rock, gravel, or like material, pad by filling with sand to form a cushion at bottom of ditch before pipe is lowered into ditch.
6. Allow any coating to harden before lowering coated pipe into ditch. Lower pipe into ditch without placing strain on pipe. Center pipe in ditch.
7. Use only approved equipment to handle and lay pipe. Do not use chain or wire rope slings.
8. Coating Application and Inspection: Per installation instructions provided by manufacturer for pre-insulated and factory-applied coatings specific to these systems.
9. Before back filling, inspect line to ensure that it lies evenly on bottom of ditch, inspect that no debris is present, and that joints are not covered until all tests are completed.
10. Protect coated piping during back-filling by hand placing selected earth free from rock and other injurious materials around pipe to a minimum depth of 12 inches above pipe's top surface.
11. Install plastic pipe per manufacturer's installation instructions.

C. Pipe Sleeves
1. Provide pipe sleeves that allow 1/4-inch annular clearance around pipe or insulation for piping passing through floors, walls, and ceilings.
2. Provide pipe sleeves that allow 1/2-inch annular clearance around pipe or insulation for underground piping passing through walls.
3. Install pipe sleeves flush with walls and ceilings.
4. Provide pipe sleeves extending 3 inches above floor surface [except where specified otherwise].
5. Provide pipe sleeves penetrating fire-zone floors and walls.
6. Pipe sleeve materials shall be carbon steel, standard weight unless otherwise indicated on drawing.

D. Valves
1. Pack and make leak-proof valves for test pressure specified.
2. Valves that are to be soldered, brazed, or welded shall be disassembled prior to heating. Allow valves parts to cool, clean if necessary, and reassemble.
3. Deliver safety valves, relief valves, safety-relief valves, pressure-control valves, pressure-reducing valves, and backflow prevention devices to Facilities Manager for testing and/or pressure setting prior to installation.
4. Install globe valves with pressure under seat.
5. Blank off valve connections provided for future expansion as follows:
   a. Flanged Valve: Provide blind flange.
   b. Threaded or Socket-Weld Valve: Provide 4-inch nipple and threaded pipe cap.
   c. Solder-Type Valve: Provide copper-to-MPT adapter and threaded brass pipe cap.
   d. Install valves with stems in upright or horizontal position.
   e. Provide manual shutoff valves to isolate equipment, parts of systems, or vertical risers.
   f. Provide manual control valves for throttling, bypass, or manual flow control.
   g. Provide check valves on discharge of pumps.
   h. In copper tube systems, provide brass male adapters on both sides of valves.
   i. Provide shutoff valves with unions downstream at equipment and fixture connections.
   j. Provide shutoff valves for branch headers as close as practical to main header.

E. Hangers and Supports
1. Design and locate pipe hangers and supports as detailed on drawings and parameters established herein. Generally provide for:
   a. 4" (100 mm) and smaller piping use standard adjustable steel clevis hangers.

b. 6" (150 mm) and larger piping use standard adjustable roller type hangers.

2. Hanger spacing shall be designed to hold piping or tubing in position without swaying, vibrating, or sagging.
3. Vertical Piping: MSS Type 8 or Type 42 clamps.
   a. Install supports for vertical steel piping every 15 feet (4.5 m).
   b. Install supports for vertical copper tubing every 10 feet (3 m).
4. Support Individual, Straight & Horizontal Piping Runs as follows:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hanger.
   c. Longer Than 100 Feet (30 m), if indicated: MSS Type 49, spring cushion rolls.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support vertical piping and tubing at base and at each floor.
8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with ½-inch (13-mm) rod.
   4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with ½-inch (13-mm) rod.
   5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
   6. NPS 8 (DN 200): 10 feet (3 m) with ¾-inch (19-mm) rod

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

3.2 JOINING METHODS

A. Threaded Joints
   1. Threads: ANSI B1.20.1.
   2. Thread pipe after bending, forging, or heat-treating operations. Where threading must be performed first, protect threads during such operations.
   3. When threading chemically cleaned pipe, use nontoxic cutting fluid containing no rust retardants or oils. After threading chemically cleaned pipe, immerse threaded end in solvent for minimum 1 minute.
   4. Apply pipe joint compound to male threads only.
   5. Do not apply thread tape to first two threads of pipe.

B. Soldered Joints
   1. Solder: Lead-free, solid-core wire type, ASTM B32 Alloy Grade Sb5.
   2. Flux: Water soluble, chemically active at soldering temperature.
   3. Perform soldering activities per ASTM B828 and CDA 404/0R.
   4. Fillet soldered joints are not permitted.

C. Flanged Joints
   1. Provide flat-face flanges and full-face gaskets where steel flanges mate with cast-iron flanged fittings, valves, or equipment.
   2. Provide full-face gaskets between cast-iron flanges.
   3. Provide flat ring-type gaskets between steel flanges equipped with raised serrated faces [except where specified otherwise].

4. Prior to bolt up, align flange faces to the design plane within 1/16-inch per foot (0.5%) measured across any diameter. Align flange boltholes to within 1/8-inch maximum offset. Assemble mating flanges flush and true.
5. Center gaskets evenly between flange faces with ring gaskets engaging fully upon raised-face flanges.
6. Provide bolts that extend through nuts by minimum one full thread when made up. Provide bolts of uniform length on a single flange.
7. Coat bolt threads with high-temperature thread joint compound prior to installation.
8. Tighten bolts uniformly to draw flanges evenly and firmly upon gasket. Use standard industrial practice for bolt tightening.

D. Hub-and-Plain-End Joints
1. Clean internal surface of hub and external surface of pipe and/or fitting to be joined to be free of dirt, mud, gravel, or other foreign material.
2. When using cut pipe, remove sharp edges by preening or lightly filing edge.
3. Insert gasket into hub. Ensure that retaining flange or collar of gasket is adjacent to face of hub.
4. Commercial Lubricants: Soap or adhesive type.
5. Apply thin coat of commercial lubricant on inside of gasket only [unless pipe manufacturer recommends lubricating plain end of pipe or fitting].
6. Align pipes to be joined to design plane within 1/16-inch per foot (0.5%) measured across any diameter.
7. Use manufacturer-recommended tools to install plain end of pipe or fitting into gasket. Ensure that tools do not damage pipe.
8. Store gaskets in undeformed condition away from excessive heat in a clean, dry area.
9. Install hub-and-plain-end pipe with hub end upstream.
10. Do not exceed deflections in hub-and-plain-end pipe shown in Table A.
11.

Table A. Limiting factors, hub-and-plain-end pipe

Nominal pipe size	Joint opening	Maximum deflection in inches with pipe lengths of	
		12 feet	18 feet
3	0.43	14.8	22.2
4	0.41	11.1	16.7
6	0.58	11.1	16.7
8	0.65	9.7	14.6
10	0.75	9.3	14.0
12	0.75	7.9	11.9
14	0.75	6.7	10.1
16	0.75	5.9	8.8

Note: Joint Opening not to exceed 0.75 inches.

E. Mechanical Joint
1. Do not exceed deflections in mechanical joint pipe shown in Table B.
2.

Table B. Limiting factors, mechanical joint pipe

Nominal pipe size Inches	Bend in one joint angle	Maximum deflection in inches with pipe lengths of 12 feet	18 feet
3	8°-18’	21	31
4	8°-18’	21	31
6	7°- 7’	18	27
8	5°-21’	13	20
10	5°-21’	13	20
12	5°-21’	13	20
14	3°-35’	9	13 ½
16	3°-35’	9	13 ½

3. Clean surfaces that contact rubber gaskets by wire brushing prior to assembly.
4. Lubricate surfaces that contact gaskets with a solution of clean, soapy water.
5. Install gland on spigot end of pipe followed with gasket.
6. Bottom spigot end of pipe in socket and properly center to provide an annular space approximately equal to pipe circumference.
7. Bring up gasket to flange of socket. Maintain approximate uniform distance between gland and flange of pipe around socket.
8. Insert bolts in properly spaced holes. Hand tightens each nut.
9. Use wrench sizes and torques in Table C to tighten nuts.
10.

Table C: Wrenches and torque

Pipe size (inch)	Bolt diameter (inch)	Wrench length (inch)	Range of torque (ft-lb)
3	5/8	8	40 to 60
4 to 24	3/4	10	60 to 90

11. Tighten bolts by drawing up on opposite pairs, beginning at bottom, then top, then sides, and lastly remaining bolts.
12. Repeat cycle of tightening bolts until bolts are within allowable torque range.
13. If effective sealing is not attained at maximum torque indicated, disassemble joint, thoroughly clean, and then reassemble.
14. Do not over-stress bolts in order to affect a seal.

F. Plastic Pipe Joints (not excluded by ASME B31.3, Paragraph 300.1.3)
1. Bonding: ASME B31.3, Paragraph A328.
2. Bonding Procedure Qualifications: ASME B31.3.
3. Bonder Performance Qualifications: ASME B31.3.
4. Inspector: ASME B31.3, Paragraphs A328.2.2 and A328.2.3.

G. Welded Joints
1. Perform welding activities per Section 18100, if applicable.

H. Brazed Joints
   1. Perform brazing activities per Section 15052, if applicable.

I. Compression Joints
   1. Clean internal surface of fitting and external surface of piping to be free of foreign materials.
   2. When using cut pipe, remove sharp edges by preening or lightly filing edge.
   3. Slide compression nut onto pipe so that broad shoulder of compression nut faces away from end of pipe.
   4. Slip ferrules onto pipe.
   5. Press threaded body of compression fitting onto end of pipe.
   6. Screw compression nut onto fitting body.
   7. Tighten with one wrench on compression nut and one wrench on fitting body per manufacturer's instructions.
   8. Do not overstress in order to affect a seal.

J. Flared Joints
   1. Clean internal surface of fitting and external surface of piping to be free of foreign materials.
   2. When using cut pipe, remove sharp edges by preening or lightly filing edge.
   3. Slide flare nut onto pipe so that tapered end of flared nut faces away from end of pipe.
   4. Clamp end of pipe into manufacturer's recommended flaring tool and screw ram into end of pipe. Remove flaring tool from pipe.
   5. Press tapered end of fitting body into flared end of pipe.
   6. Screw flared nut onto fitting body.
   7. Tighten with one wrench on flared nut and one wrench on fitting body per manufacturer's instructions.
   8. Do not overstress in order to affect a seal.

END OF SECTION 15050