

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Divisions 00 and 01, apply to this Section.
- B. Related Sections:
 - 1. Division 23.

1.2 SUMMARY

- A. This Section includes steam, condensate, safety valve discharge and blowdown piping, and specialties for steam systems up to 125 psig, inside the building; and boiler feedwater system piping up to 250 psig.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data including rated capacities where applicable, furnished options and accessories, and installation instructions for safety relief valves, pressure-reducing valves, and steam traps.
- C. Shop Drawings: Provide the following:
 - 1. Plan layout drawings of all piping systems covered under this section. Drawings shall be 1/4-inch = 1'-0" scale and indicate location of all equipment, pipe, fittings, valves, supports and accessories. Drawings shall include dimensions, weights, loading at each support point, required clearances for equipment service and location and size of each field connection.
 - 2. Details of pipe supports, anchors, expansion joints, flash tank assemblies and equipment connections.
- D. Maintenance data for steam and condensate specialties and special-duty valves to include in the operation and maintenance manual specified in Division 01.
- E. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with the following provisions:

1. ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.
3. Welding Standards: Qualify welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

1.6 COORDINATION

- A. Coordinate layout and installation of piping and flash tanks with steam and condensate equipment and with other installations.
- B. Coordinate pipe sleeve installation for foundation wall penetrations.
- C. Coordinate installation of roof curbs, equipment and pipe supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete housekeeping pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- F. Coordinate installation of pipe sleeves for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

- A. General: Refer to Part 3 pipe application articles for identifying where the following materials are used.
- B. Steel Pipe, 2-Inch NPS and Smaller: ASTM A 106, Type S (seamless), Grade B, Schedules 40 and 80, plain ends, unless threaded allowed in Pipe Applications.
- C. Steel Pipe, 2-1/2- to 12-Inch NPS: ASTM A 53, Type E (electric-resistance welded), Grade B, Schedules 40 and 80, plain ends.
 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedules 40 and 80, carbon steel, seamless for 2-inch NPS and smaller and electric-resistance welded for 2-1/2-inch NPS and larger.

2.2 FITTINGS

- A. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300.
- B. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- C. Wrought-Steel Fittings: ASTM A 234, Schedules 40 and 80.

- D. Forged Socket-Welding Fittings: ASME B16.11; Class 3000 (Schedule 80).
- E. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, Material Group 1.1, raised face type with butt-welding connections; include nuts and bolts.
- F. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure, 250 deg F maximum operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

2.3 JOINING MATERIALS

- A. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- B. Flange Gasket: Flexible spiral wound metal gasket, type suitable for 125 psig steam service. Flexitallic or Garlock manufacturers.

2.4 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 23 Section "General-Duty Valves for Mechanical Piping."
- B. Refer to Part 3 "Valve Applications" Article for specific uses and applications for each valve specified.

2.5 SAFETY VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Safety Valves:
 - a. Kunkle Inds. Inc.; Kunkle Valve Div.
 - b. Spirax Sarco, Inc.
 - c. Conbraco.
 - d. Or Approved Equal
- B. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code. Furnish complete with cast-iron drip-pan elbow having threaded inlet and outlet with threads conforming to ASME B1.20.1.
- C. Bronze Safety Valves: Cast-bronze or forged copper body, Class 250, with threaded inlet and outlet; forged copper-alloy disc; fully enclosed, cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
- D. Cast-Iron Safety Valves: Cast-iron body, Class 250; forged copper-alloy disc and nozzle; fully enclosed, cadmium-plated steel spring with adjustable pressure range and positive shutoff; raised-face flanged inlet and threaded outlet connections; factory set and sealed.

- E. Stop-Check Valves: Class 250, malleable-iron body and bonnet, cylindrical disc, removable liner and machined seat, brass-alloy stem, outside screw and yoke, polytetrafluoroethylene (PTFE)-impregnated packing with 2-piece packing gland assembly, flanged end connections, and cast-iron handwheel.

2.6 STEAM PRESSURE-REGULATING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steam Pressure Regulating Valves:
 - a. Armstrong International, Inc.
 - b. Leslie Controls, Inc.
 - c. Spence Engineering Co., Inc.
 - d. Spirax Sarco, Inc.
 - e. Or Approved Equal
- B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.
- C. Valve Characteristics: Self-operated, external pilot type, single seated, metal diaphragm actuated – Spence Type ED or equal by Armstrong or Sarco, valves equipped with adjustable pressure range and positive shutoff; cast-iron body with threaded connections for 2-inch and smaller and flanged end connections over 2-1/2-inch, hardened stainless-steel trim, and replaceable head and seat. Provide main head stem guide fitted with flushing and pressure-arresting device. Provide dirt cover over pilot diaphragm.

2.7 STEAM TRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steam Traps:
 - a. Armstrong International, Inc.
 - b. Spirax Sarco, Inc.
 - c. Or Approved Equal
- B. Thermostatic Traps: Cast bronze, angle pattern body with integral union tailpiece and screw-on cap; maximum operating pressure of 50 psig; balanced-pressure, stainless steel or Hastelloy wafer, or phosphor bronze bellows element and renewable, stainless steel seat.
- C. Float and Thermostatic Traps: Cast iron body and bolted cap with maximum allowable and maximum working pressures not less than steam supply pressure. Renewable, stainless steel float mechanism with renewable, hardened stainless steel or chrome steel valve and valve seat. The valve shall be attached to the valve lever in such a manner that it will be free to rotate. The valve and valve seat shall be lapped together and installed as a paired set. Orifice size shall be stamped on the valve seat to aid in identifying proper replacement parts. Balanced-pressure thermostatic air vent made with stainless steel or phosphor bronze bellows, and stainless steel seat.
 - 1. Accessories:

- a. Integral vacuum breaker.
- D. Inverted Bucket Traps: Cast iron body and bolted cap with maximum allowable and maximum working pressures not less than steam supply pressure. The steam trap mechanism shall be a free-floating lever design with no fixed pivot points, and the valve shall be attached to the valve lever in such a manner that it will be free to rotate. The valve and valve seat shall be of stainless steel or heat-treated chrome steel, lapped together and installed as a paired set. Stainless-steel valve lever, valve retainer, guide plate assembly, and bucket. Steam trap mechanism shall be renewable, and the orifice size of the mechanism shall be stamped on the valve lever, valve seat, and guide plate to aid in identifying proper replacement parts.
 - 1. Accessories:
 - a. Integral stainless-steel inlet strainer within trap body.
 - b. Internal stainless-steel, spring loaded check valve.
 - c. Bi-metal thermic vent.

2.8 INVERTED BUCKET STEAM TRAP VALVE STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Inverted Bucket Steam Trap Valve Station:
 - a. Armstrong International, Inc.
 - b. Or Approved Equal
- B. General: The Trap Valve Station shall be inverted bucket type complete with integral piston isolation valves. The steam trap mechanism shall be a free-floating valve design with no fixed pivots. The trap body shall be made of cast iron with ground and lapped stainless steel valve and seat. Trap shall be capable of pressures to 250 psig at 450°F. The assembly shall include integral isolation valves to enable in-line repair of trap internals. Integral isolation valves shall be piston style that does not require a metal-to-metal seat for isolating flow. The valves shall be in-line repairable.
 - 1. The Trap Valve Station shall include the following accessories:
 - a. Integral strainer.
 - b. Check valve.
 - c. Thermic bucket vent.

2.9 THERMOSTATIC AIR VENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Thermostatic Air Vents:
 - a. Armstrong International, Inc.
 - b. Spirax Sarco, Inc.
 - c. Or Approved Equal

- B. General: Cast-iron or brass body, with balanced-pressure, stainless steel or phosphor bronze thermostatic bellows, and stainless-steel seats.

2.10 VACUUM BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Vacuum Breakers:

- a. Armstrong International, Inc.
 - b. Spirax Sarco, Inc.
 - c. Or Approved Equal

- B. General: 150-psig steam working pressure, 365 deg F maximum operating temperature, brass or stainless-steel body, stainless-steel retainer, spring, and ball, with plain or threaded outlet.

2.11 STRAINERS

- A. Y-Pattern Strainers: Minimum 250-psig steam working pressure; cast-iron body, Type 304 or 316, 0.045-inch stainless-steel perforated screen with 20 mesh stainless steel screen liner for 2-inch NPS and smaller, and manufacturer recommended perforations for 2-1/2-inch NPS and larger; tapped blowoff plug. Threaded connections for 2-inch NPS and smaller and flanged connections for 2-1/2-inch NPS and larger.
- B. Basket Strainers: Minimum 250-psig steam working pressure; cast-iron body, Type 304 or 316, 0.045-inch stainless-steel perforated screen; bolted cover; flanged connections.

2.12 EDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Eductors:

- a. Jacoby-Tarbox
 - b. Penberthy
 - c. Or Approved Equal

- B. General: Two-piece stainless steel venturi type jet pump eductor, rated at 200 psig at 400 degrees F.

2.13 FLASH TANKS

- A. Construct of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig rating. Fabricate with tapings for vents, low-pressure steam and condensate outlets, high-pressure condensate inlet, thermostatic air vent, pressure gauge, safety valve, and legs.

2.14 BACK PRESSURE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Back Pressure Valves:

- a. Armstrong International, Inc.
- b. Spence Engineering Co., Inc.
- c. Spirax Sarco, Inc.
- d. Or Approved Equal

B. General: Self-operated, external pilot type, throttling back-pressure valve; cast-iron body with threaded connections for 2-inch and smaller and flanged end connections over 2-1/2-inch, hardened stainless-steel trim, and replaceable head and seat.

2.15 BLOWDOWN SEPARATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Blowdown Separator:

- a. Penn Separator
- b. Industrial Steam
- c. Or Approved Equal

B. General: Centrifugal type steam blowdown separator with tangential inlet. Constructed from welded steel, minimum 3/8-inch thick, rated at 50 psig working pressure at 350 degrees F, ASME stamp required. Stainless steel strike plate at point of inlet impingement. Steel legs suitable for floor mounting. Drain tempering fitting with non-potable cold water connection, thermometer and temperature sensing bulb to limit drainage liquid to 140 degrees F maximum. Temperature regulating valve to be shipped loose for field installation. Vent connection on top of separator to vent separator to atmosphere. Connections 2-inches and below shall be threaded; 2-1/2-inches and larger shall be flanged.

2.16 SAMPLE COOLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sample Coolers:

- a. J.L. Wingert Co.
- b. Or Approved Equal

B. General: Boiler surface blowdown and condensate sample cooler. Constructed from Schedule 40 steel pipe and C1215 and plugs. Cooling coil constructed of 1/4-inch diameter by 20-feet, Type 316 stainless steel. Wall mounting bracket with 1/4-inch FNPT Type 316 stainless steel connection fittings for sample liquid. Maximum operating conditions for the sample liquid 1500 psig, 600 degrees F; for the cooling water 200 psig, 250 degrees F.

2.17 BYPASS AND TEST ORIFICES

- A. Solid stock machined nipple type, nozzle type orifice in a flanged joint; to meet flow and pressure drop indicated.

2.18 STEAM EXHAUST SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steam Exhaust Silencers:
 - a. Maxim
 - b. Or Approved Equal
- B. General: In-line steam exhaust silencer, insertion loss 40 dBA overall reduction, constructed of ASTM A36 carbon steel, horizontal configuration, 150 lb flanged inlet and outlet connections, rated at 150 psig working pressure. Provide 1-inch drain connection. Finish with high temperature flat black paint.

2.19 STEAM EXHAUST HEAD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steam Exhaust Head:
 - a. Penn Separator
 - b. Bryan
 - c. Or Approved Equal
- B. General: Steam discharge termination exhaust head. ASTM A36 carbon steel construction with expansion chamber, impingement cone and catch trough and drain. 150 lb flanged inlet connection.

2.20 PIPE ANCHORS

- A. Pipe anchors constructed from ASTM A36 structural steel shapes and plate. Anchors shall be designed by a licensed Structural Engineer for the forces and moments indicated on the drawings.

PART 3 – EXECUTION

3.1 PIPE APPLICATIONS LESS THAN 15 PSIG

- A. Steam Piping, 2-Inch NPS and Smaller: Schedule 40 steel pipe with threaded joints and Class 150 malleable-iron fittings.
- B. Steam Piping, 2-1/2- to 12-Inch NPS: Schedule 40 steel pipe with welded joints, Schedule 40 wrought-steel welding fittings, and Class 150 wrought-steel flanges.
- C. Condensate Piping, 2-Inch NPS and Smaller: Schedule 80 steel pipe with threaded joints and Class 300 malleable-iron fittings.

- D. Condensate Piping, 2-1/2- to 12-Inch NPS: Schedule 80 steel pipe with welded joints, Schedule 80 wrought-steel welding fittings, and Class 150 wrought-steel flanges.

3.2 PIPE APPLICATIONS UP TO 125 PSIG

- A. Steam and Safety Valve Discharge Piping, 2-Inch NPS and Smaller: Schedule 40 steel pipe with threaded joints and Class 300 malleable-iron fittings.
- B. Steam and Safety Valve Discharge Piping, 2-1/2- to 12-Inch NPS: Schedule 40 steel pipe with welded joints, Schedule 40 wrought-steel butt-welding fittings, and Class 150 wrought-steel flanges.
- C. Condensate Piping, 2-Inch NPS and Smaller: Schedule 80 steel pipe with threaded joints and Class 300 malleable-iron fittings.
- D. Condensate Piping, 2-1/2- to 12-Inch NPS: Schedule 80 steel pipe with butt-welded joints, Schedule 80 wrought-steel butt-welding fittings, and Class 150 wrought-steel flanges.
- E. Blowdown Piping, 2-Inch NPS and Smaller: Schedule 80 steel pipe with socket-welded joints and Class 3000 socket-welding fittings.
- F. Blowdown Piping, 2-1/2- to 12-Inch NPS: Schedule 80 steel pipe with butt-welded joints, Schedule 80 wrought-steel butt-welding fittings, and Class 150 wrought-steel flanges.

3.3 PIPE APPLICATIONS UP TO 250 PSIG

- A. Boiler Feedwater and Boiler Feedwater Bypass, 1-1/2-Inch NPS and Smaller: Schedule 80 steel pipe with socket-welded joints and Class 3000 socket-welding fittings.
- B. Boiler Feedwater and Boiler Feedwater Bypass, 2-inch NPS and Larger: Schedule 80 steel pipe with butt-welded joints, Schedule 80 wrought-steel butt-welding fittings, and Class 300 wrought-steel flanges.

3.4 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Gate valves.
 - 2. Throttling Duty: Globe valves.
- B. Install shutoff-duty valves at each branch connection to supply mains, at inlet connection to each steam trap, and elsewhere as indicated.
- C. Vacuum Breakers Less than 15 psig: Class 150 bronze swing check with composition seat.

3.5 STEAM-TRAP APPLICATIONS

- A. Thermostatic Traps: [Convectors][and][finned-tube radiation].
- B. Float and Thermostatic Traps: [As indicated on Steam Trap Schedule][Steam main and riser drip legs][,][laundry equipment][,][kitchen equipment][,][heat exchangers] [and] [coils].

- C. Inverted Bucket Traps: [As indicated on Steam Trap Schedule][Steam main][,][heat exchangers][,][and] [riser drip legs].

3.6 PIPING INSTALLATIONS

- A. Install piping according to Division 23 Section "Common Mechanical Materials and Methods."
- B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install steam supply piping at a uniform grade of 0.2 percent downward in direction of flow.
- D. Install condensate return piping at a uniform grade of 0.5 percent downward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- F. Install branch connections to steam mains using 45-degree fittings in main with takeoff out top of main. Use of 90-degree tee fittings is permissible where 45-degree fittings are impractical. Where length of branch takeoff is less than 10 feet, pitch branch line down toward mains at 0.4 percent slope.
- G. Install unions or flanges adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated.
- H. Install strainers on supply side of each control valve, steam pressure-regulating valve, solenoid valve, traps, and elsewhere as indicated. Install 3/4-inch NPS nipple and ball valve in blow-down connection of strainers 2-inch NPS and larger. Match size of strainer blowoff connection. Provide gate valve with close nipple and pipe cap at blowdown connection.
- I. Install pipe anchors where indicated and where required to ensure proper pipe expansion and contraction.
- J. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, control valves, isolation valves, pipe bends, and expansion joints.
1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet where pipe is pitched down in direction of steam flow and a maximum of 150 feet where pipe is pitched in opposite direction of steam flow.
 2. Drip leg is to be same size as steam line up to 4-inches. Above 4-inches, drip leg is to be half of steam line size, but not less than 4-inches. Inlet to steam trap shall be located at least 18 inches below steam line. Provide gate valve at bottom of drip leg to allow removal of dirt and scale.
 3. Equip drip legs, dirt pockets, and strainer blow-downs with gate valves to allow removal of dirt and scale.
 4. Install steam traps close to drip legs.
- K. Flash Tanks: Pitch condensate lines toward flash tank. If more than one condensate line discharges into flash tank, install a swing check valve in each line. Install thermostatic air vent at top of tank. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for triple condensate load. Install safety relief valve at tank top.

Install pressure gage on tank, and gate valve and swing check valve on low-pressure (flash) steam outlet.

3.7 STEAM-TRAP INSTALLATION

- A. Install steam traps in locations that provide access for inspection and maintenance, and as close as possible to connected equipment. Trap Valve Station having integral isolation valves, strainer, and check valve is an acceptable alternate for inverted bucket traps.
 - 1. Unless otherwise indicated, install gate valve, strainer, and union upstream from trap; install union, check valve, and gate valve downstream from trap.
 - 2. Install trap a minimum of 18-inches below the bottom of the coil or heat exchanger.

3.8 STEAM PRESSURE-REGULATING VALVE INSTALLATIONS

- A. Install pressure-regulating valves as required to regulate system pressure, in readily accessible location for maintenance and inspection.
- B. Provide bypass around regulating valve station, with globe valve equal in size to area of regulating valve seat ring.
- C. Install gate valves and unions around each regulating valve. Unions may be omitted for regulating valves with flanged connections.
- D. Install pressure sensing tube as per manufacturer's recommendations.
- E. Install pressure gages on low-pressure side of each regulating valve and ahead of shutoff valve, plus one downstream for shutoff valve.
 - 1. On 2-stage reducing stations, install drip trap and pressure gage upstream from second stage regulating valve.
- F. Install strainers upstream for each regulating valve.
- G. Install safety valves downstream from regulating valve station.

3.9 SAFETY VALVE INSTALLATIONS

- A. Install valves according to ASME B31.1. Pipe discharge to atmosphere outside building, without stop valves. Install drip-pan elbow fitting adjacent to safety valve; pipe drain connection to nearest floor drain. Comply with ASME Boiler and Pressure Vessel Code installation requirements.

3.10 BLOWDOWN SEPARATOR INSTALLATIONS

- A. Install blowdown separator per the manufacturer's recommendations.
- B. Install shut-off ball valve, union and strainer upstream of the temperature regulator valve.

3.11 SAMPLE COOLER INSTALLATIONS

- A. Mount coolers to wall in upright configuration. Do not kink sample tubes.

3.12 TERMINAL EQUIPMENT CONNECTIONS

- A. Piping size for supply and return shall be same size as equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. Where multiple, parallel control valves are installed, only one bypass is required.
- D. Install vacuum breaker downstream from control valve and bypass, and close to coil inlet connection.
- E. Install pressure gage at coil inlet connections.
- F. Install a drip leg at coil outlet with steam trap located at least 18-inches below coil outlet.

3.13 HANGERS AND SUPPORTS

- A. General: Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment." Conform to requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
- C. Install hangers for steel piping with the following minimum rod sizes and maximum spacing:

Nom. Pipe Size (Inches)	Steel Pipe Max. Span (Feet)	Min. Rod Diameter (Inches)
Up to 3/4	7	1/4
1	7	1/4
1-1/4	7	3/8
1-1/2	9	3/8
2	10	3/8
2-1/2	11	1/2
3	12	1/2
4	14	5/8
6	17	3/4
8	19	7/8
10	20	7/8
12	23	7/8

- D. Support vertical runs at each floor or at maximum spacing of 15'-0", whichever is less.

3.14 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Mechanical Materials and Methods" for joint construction requirements for threaded, welded, and flanged joints.

3.15 FIELD QUALITY CONTROL

- A. Testing Preparation: Prepare steam and condensate piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Flush system with clean water. Clean strainers.
 3. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
 4. Install relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Testing: Test steam and condensate piping as follows:
1. Notify Owner or Owner's Representative a minimum of 10 working days prior to testing. Test to be witnessed by Owner or Owner's Representative.
 2. Use ambient temperature water as testing medium, except where there is risk of damage due to freezing. Another liquid may be used if it is safe for workers and compatible with piping system components.
 3. Use traps installed at the high points of system to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.

3.16 CLEANING

- A. Preparation:
1. System shall be operational prior to cleaning.
 2. Make temporary piping connections, furnish temporary pumps, and temporary bypass filter as required to properly accomplish cleaning entire system.
 3. Place all manual, pressure regulating and control valves serving the system in open position during cleaning so that circulation through the system is obtained during cleaning. Isolate and bypass steam pressure regulating station.
 4. Verify that electric power is available and of the correct characteristics for any cleaning equipment.
- B. Cleaning Sequence:

1. Initial Flush (all systems):
 - a. Completely fill the system with fresh water and circulate (1st filling) for 4-hour minimum.
 - b. Initial flushing shall be sufficient to remove all contaminants such as cuttings, filings, loose rust and scale, welding and soldering, residue and debris.
 - c. Drain the entire system and refill with fresh water (2nd filling).
2. Cleaning Flush:
 - a. Use concentrated chemical cleaner in piping system(s). Cleaner shall be a phosphate wetting agent combined with an alkaline surfactant with a sodium carbonate type alkalinity supplement introduced as necessary to produce 600 PPM of phenolphthalein alkalinity. Chemicals shall be nontoxic.
 - b. Circulate the solution for the recommended time period corresponding to the fluid temperature.
 - 1) Partially close and reopen all manual valves several times.
 - c. Test solution for proper concentration and document results.
 - d. Completely drain the entire system.
 - e. Refill the system with fresh water (3rd filling). Then, with the circulation pump running:
 - 1) Open one or more drains as far downstream from the fill point as is possible. Be sure the makeup is sufficient to keep up with the drain so as to maintain full system.
 - 2) Partially close and reopen all manual valves several times.
 - 3) Blowdown all strainers, dead legs and low points in the system.
 - 4) Continue to flush the system in this manner until the drain water is of the same clarity as the makeup water and testing reveals no further traces of cleaning solution (minimum 1 hour). Document the results.
 - f. Following the fresh water flush, drain the entire system.
 - 1) Clean all strainers.
3. Upon completion of cleaning and chemical treatment addition, tag the system so that tag is plainly visible as follows: "THIS SYSTEM HAS BEEN CHEMICALLY CLEANED AND TREATED."
4. Field Reports: Submit field report indicating analysis of system's water after cleaning and after chemical treatment.

END OF SECTION