DIVISION 23

SECTION 23 22 13

STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide steam and condensate return pipes, pipe fittings, pipe specialties, steam traps, and pipe supports as shown on the Drawings, and as needed for a complete and proper installation.

B. This Section includes the following for low pressure steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Safety valves.
4. Pressure-reducing valves.
5. Steam traps.
6. Steam separators.
7. Pressure, Vacuum and Compound Gauges
8. Thermometers

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Steam and Condensate Return Piping:

System: Low Pressure Steam, Condensate Return and Blowdown
Operating Pressure: 0-15 psig
Operating Temperature: 212ºF to 250ºF
Design Code: ANSI B31.9

B. Domestic Cold Water Makeup Piping:

Operating Pressure: 125 psig
Operating Temperature: 40ºF to 60ºF
Design Code: ANSI B31.9

C. Boiler Feedwater, Equalizer, Blowdown and Pumped Condensate Return Piping:

Operating Pressure: 125 psig
Operating Temperature: 212ºF to 250ºF
Design Code: ANSI B31.9

D. Boiler Chemical Feed Piping:

Operating Pressure: 125 psig
Operating Temperature: 50ºF to 70ºF
Design Code: ANSI B31.9

E. Condensing Type DHW Heaters Chimney Breeching Rain Drain and Condensate Drain Piping:

Operating Pressure: 125 psig
Operating Temperature: 40ºF to 70ºF
Design Code: ANSI B31.9

1.03 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections:

1. Section 01 51 23 - Temporary Heating
2. Section 23 05 00 – Common Work Results For HVAC
3. Section 23 05 13 - Common Motor Requirements For HVAC Equipment
4. Section 23 05 23 - General Duty Valves For HVAC Piping
5. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
6. Section 23 05 53 - Identification for HVAC Piping and Equipment
7. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
8. Section 23 07 00 - HVAC Insulation
9. Section 23 09 13 - Instrumentation and Control for HVAC
10. Section 23 09 14 - Natural Gas and CO Gas Leak Detection Equipment
11. Section 23 09 23 - Control Dampers
12. Section 23 09 24 - Steam Flow Meters
13. Section 23 22 13 - Steam and Condensate Heating Piping
14. Section 23 25 19 - Water Treatment for Steam System Feedwater
15. Section 23 31 13 - Metal Ducts
16. Section 23 33 00 - Air Duct Accessories
17. Section 23 34 16 - Boiler Room Combustion Air Makeup And Ventilation System
18. Section 23 51 00 - Chimney Liner
19. Section 23 51 16 - Prefabricated Breechings and Accessories
20. Section 23 51 23 - Gas Vents
21. Section 23 52 39 - Firetube Boilers
22. Section 23 53 12 - Vacuum Condensate Pumps
23. Section 23 53 13 - Boiler Feedwater Pumps

1.04 DEFINITIONS

A. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.05 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. LP Steam Piping: 175 psig.
2. Condensate Piping (including boiler feed water piping): 175 psig at 250 deg F.

3. Blowdown-Drain piping: Equal to pressure of the piping system to which it is attached.
4. Safety-Valve-Inlet and –Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.06 SUBMITTALS

A. Product Data: For each type of the following: Submit schedule showing pipe or tube weight, fitting and joint type for each piping system; size, location and feature for each piping specialty, expansion compensation, hanger and support, valve, steam trap and steam separator.

B. Shop Drawings: Detail, 1/4 inch equals 1 foot scale, and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops. Provide shop drawings of all HVAC lines including but not limited to showing all diameters, pitch, cleanouts, traps, routings, terminations, shut-off valves, vents, riser drains, etc.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control reports.

F. For expansion bolts installed in concrete, submit ICC certification for use in cracked concrete.

G. Operation and Maintenance Data: For valves, steam traps, steam separators and meters to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Codes and Standards:

1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of

piping work and ASME Boiler and Pressure Vessel Code, Section IX, Part QW Welding or in accordance with AWS B2.1 Specifications for Welding Procedure and Performance Qualification per Section MC 1203.3.6 of the 2014 NYC Mechanical Code.

2. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

3. Brazing: Certify brazing procedures, brazers, and operations in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Part QB Brazing for shop and job-site brazing of piping work or in accordance with AWS B2.2 standard for Brazing Procedure and Performance Qualification per Section MC 1203.3.1.

4. Fluid Control Institute (FCI) Compliance: Test and rate "Y" type strainers in accordance with FCI 73 1: Pressure Rating Standard for "Y" Type Strainers. Test and rate other type strainers in accordance with FCI 78-1: Pressure Rating Standard for Pipeline Strainers Other than "Y" Type.

5. EJMA Compliance: Construct expansion compensation products in accordance with standards of the Expansion Joint Manufacturer's Association (EJMA).

6. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with:

   a. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.

   b. MSS SP-69 Pipe Hangers and Supports - Selection and Application.

   c. MSS SP-89 Pipe Hangers and Supports - Fabrication and Installation Practices.

   d. Piping shall be supported at distances not exceeding the spacing specified in MC Table 305.4 or in accordance with the above MSS standards.

7. Comply with ANSI B31.1A, ASME Code for pressure Piping, and ASHRAE Equipment Guide.

8. New York City Construction Codes: Comply with the 2014 New York City Building Code, Mechanical Code, Fuel Gas Code, Plumbing Code and Fire Code.

9. Testing of material shall be in accordance with Section §28-113 of the NYC Administrative Code (reference Section MC 301.5). Whenever the NYC Construction Codes or the Rules of the Department of Buildings requires that material be listed or labeled and material proposed to be used is not so listed or labeled, the use of such material shall be subject to prior approval by the Commissioner (Office of Technical Certification and Research OTCR) and such material shall be used only to the extent set forth in such approval. Materials that were previously approved by the Board of Standards and Appeal (BSA) or by the Department (MEA) before the effective date of the NYC Construction Codes may continue to be used, but only to the extent set forth in such approval, and only if such approval is not specifically amended or repealed by the Commissioner.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS ONLY FOR COLD WATER MAKEUP PIPING

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B), ASTM B 88, Type M (ASTM B 88M, Type C).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade B, and Schedule as indicated in Part 3 piping applications articles.

B. Stainless Steel Tubing (for Condensing Type DHW Heater Chimney/Breeching Drains): ASTM 316-L, seamless tubing and fittings, plain ends, 0.028-inch wall thickness, welded joints.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.

E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

F. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

I. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12 (AWS D10.12M) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. 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.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries, International Inc.
d. Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group.

2. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

a. Capitol Manufacturing Company.

b. Central Plastics Company.
c. Watts Water Technologies, Inc.

3. Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

2.05 VALVES

A. Gate, Globe, Check, and Ball Valves: Comply with requirements specified under Section 23 05 23 "General-Duty Valves for HVAC Piping."

B. Steam Boiler Stop-Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

a. Crane Co.
b. Jenkins Valves; a Crane Company.
c. Lunkenheimer Valves.
d. A.Y. McDonald Mfg. Co.

2. Body and Bonnet: Malleable iron.
3. End Connections: Flanged.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
8. Pressure Class: 250.

2.06 COMPONENTS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig (1725-kPa) working steam pressure.
6. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

   Anvil International
   Armstrong Machine Works
   Conbraco Industries, Inc.
   Hoffman Specialty ITT; Fluid handling Div.
   Spirax Sarco
   Mueller Steam Specialty

2.07 STEAM TRAPS

A. Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

   a. Armstrong International, Inc.
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty; Division of ITT Industries.
   e. Spirax Sarco, Inc.
   f. Sterling.

2. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
3. Trap Type: Balanced-pressure.
4. Bellows: Stainless steel or monel.
5. Head and Seat: Replaceable, hardened stainless steel.
6. Pressure Class: 125.

B. Float and Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.

2. Body and Bolted Cap: ASTM A 126, cast iron.

3. End Connections: Threaded.

4. Float Mechanism: Replaceable, stainless steel.

5. Head and Seat: Hardened stainless steel.

6. Trap Type: Balanced pressure.

7. Thermostatic Bellows: Stainless steel or monel.

8. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.

9. Maximum Operating Pressure: 125 psig (860 kPa).

2.08 STEAM SEPARATORS, (If Applicable, Only If Indicated On Contract Drawings)

A. Steam separators shall be designed and constructed in accordance with the latest ASME Code Sec. VIII, Div. 1 of the Boiler and Pressure Vessel Code. The vessel shall be manufactured in steel with a red oxide primer. The separator shall include a helical baffle to maximize the separation and reduce noise level. The separator shall also include a gauge glass. The separator shall be rated for maximum working pressure of 150 psig at 450° F and hydrostatically tested at 195 psig.

B. Steam separators must produce a minimum of 98% steam quality when steam enters the separators with the minimum quality of 90% and rate of 11,000 pounds per hour at 10 psig. The pressure drop across the separator shall not exceed 10 inches of water column.

C. Steam separators shall be with flanged connections and shall be compatible with steam pipe size. The flanged connections shall be 150 lbs ANSI class.

D. The separators shall be certified for guaranteed performance by the manufacturer of the steam separators.

E. The steam separators shall be insulated with 3" asbestos free material as specified in these specifications Section 23 07 19.

F. Reducers shall be provided as required for the proper installation of separators.

G. Separator material specifications:

Heads: SA516-70
Shell: SA53B
Pipe: SA53B
Coupling: SA105

Flanges: SA105
Finish: Red Oxide Primer

H. Steam separators shall be Penn Corp., horizontal in-line separators Model ISH 12-24, or approved equal.

2.09 PRESSURE, VACUUM AND COMPOUND GAUGES

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

B. Gauges shall comply with Federal Specification GG-G-76 and shall be high grade, single Bourdon spring type with heavy, moisture proof cast bronze cases and silvered faces with cut black figures. All gauges shall have shut-off cocks; in addition, steam gauges shall have water seals.

C. Operating point of gauges shall be approximately at midpoint of scale. Accuracy of gauges shall be within 1% of scale range without frequent adjustments.

D. For gauges on boilers, refer to the specified requirements of Section 23 52 39.

2.10 THERMOMETERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

B. Thermometers shall be dial type, mercury actuated for installation with brass or bronze separable sockets. Sockets shall project above pipe insulation.

C. Thermometer cases shall be cast bronze or stainless steel. Thermometers and sockets shall conform to Federal Specification GG-T-321.

PART 3 - EXECUTION

3.01 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. LP Steam Piping, NPS 2-1/2 and larger: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Steam Condensate Return, Equalizer, Pumped Condensate Return, Chemical Feed and Blowdown-Drain piping, NPS 2 and smaller, shall be:

1. Schedule 80, Type S, Grade B, steel pipe; Class 125 extra-heavy-weight cast-iron fittings; and threaded joints.

D. Steam Condensate Return, Equalizer, Pumped Condensate Return and Blowdown-Drain piping, NPS 2-1/2 and larger, shall be:

1. Schedule 80, Type E, Grade B, steel pipe; Class 150 extra-heavy weight wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.02 ANCILLARY PIPING APPLICATIONS

A. Steam Boiler Safety-Valve-Outlet Piping: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

B. Condensate Pump Receiver Vent and Drain Piping: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

C. Condensing Type DHW Heater Chimney/Breeching Rain and Condensate Drains: Stainless Steel Tubing: ASTM 316-L, seamless tubing and fittings, plain ends, 0.028-inch wall thickness, welded joints. Provide a P-Trap at connection to base of prefabricated double-wall chimney cleanout cap. Drain piping shall pitch downward in the direction of flow at least 1/8-inch per linear foot, and shall drop to spill in proximity of floor drain.

D. Cold Water Makeup Supply: Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B), ASTM B 88, Type M (ASTM B 88M, Type C).

3.03 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install steam safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

C. Provide a new full-line-size isolation valve at each junction of new-to-existing piping, to provide isolation of existing piping system from subjection to hydrostatic test pressures of new piping systems, as specified.

3.04 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Install piping to allow application of insulation.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

J. Install drains, consisting of a tee fitting, NPS 3/4 gate valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

K. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

L. Install condensate return piping and floor-trench mounted blowdown drain piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

M. Boiler equalizer piping within floor trench shall be installed horizontally without any pitch.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.

P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

R. Install strainers on supply side of control valves, steam traps, condensate return pump sets and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

S. Flexibility in piping systems subjected to thermal expansion and contraction shall be provided by means of expansion loops, offsets and zee-bends in the piping system. Install expansion loops, anchors, and pipe alignment guides as necessary to maintain alignment of piping under thermal expansion and contraction. Where Contract Drawings do not specifically indicate requirements for provision of anchors of piping to

structural framing, the piping is intended to “float” under thermal expansion and contraction.

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

U. Install drip legs at low points and natural drainage points such as ends of mains, ends of headers, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 100 feet (30 m).
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

3.05 STEAM TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.06 STEAM METER INSTALLATION

A. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.

B. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation and Control for HVAC.”

3.07 SAFETY VALVE INSTALLATION

A. Install boiler factory provided safety valves according to ASME B31.1, "Power Piping.", ASME B31.9, "Building Services Piping.

B. Pipe safety-valve discharges shall terminate at elevation 6-inches above finished floor level, without valves, to atmosphere in proximity of local floor drain.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.08 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 9 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 9 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 21 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 24 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 26 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 30 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 32 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 35 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 37 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 39 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 1/2: Maximum span, 4 feet; minimum rod size, 1/4 inch.
2. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.09 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints In Copper Tubing: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12 (AWS D10.12M), using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads

3.10 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than 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. If parallel control valves are installed, only one bypass is required.

3.11 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.

3. 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, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

END OF SECTION