

SECTION 23 20 00
HVAC PIPING AND JOINTS-STEAM & CONDENSATE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

- A. Furnish and install steam and condensate piping, fittings, flanges, unions, bolting, gaskets, welding, and threading for piping network, branches and connections to all new and existing radiators where indicated to make complete and operational systems.
- B. All systems shall be installed in accordance with local code including vent piping and relief discharge termination points.
- C. Secure all permits and local/state approvals for the installation of all components included under this Section.
- D.

1.03 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.04 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. ASME: American Society of Mechanical Engineers
- C. NFPA: National Fire Protection Association
- D. ANSI: American National Standards Institute
 - 1. A13.1: Scheme for Identification of Piping Systems
 - 2. B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 - 3. B16.3: Malleable Iron Threaded Fittings
 - 4. B16.4: Cast Iron Threaded Fittings
 - 5. B16.5: Pipe Flanges and Flanged Fittings
 - 6. B16.9: Factory Made Wrought Steel Butt Weld Fittings
 - 7. B16.11: Forged Steel Fittings, Socket Weld and Threaded
 - 8. B16.15: Cast Bronze Threaded Fittings
 - 9. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
 - 10. B16.20: Metallic Gaskets for Pipe Flanges
 - 11. B16.21: Non Metallic Flat Gaskets for Pipe Flanges
 - 12. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - 13. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 800, 1500 and 2500
 - 14. B182.1 Square and hex bolts and screws
 - 15. B182.2 Square and hex nuts
 - 16. B16.39: Malleable Iron Threaded Pipe Unions
 - 17. B16.42: Ductile Iron Pipe Flanges and Flanged Fittings
 - 18. B31.1: Power Piping
 - 19. B36.10: Welded and Seamless Wrought Steel Pipe

- 20. Z49.1: Safety in Welding and Cutting
- E. ASTM: American Society for Testing and Materials
 - 1. A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 2. A 105/A105M: Forgings, Carbon Steel, for Piping Components
 - 3. A 135: Electric-Resistance-Welded Steel Pipe
 - 4. A 153: Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - 5. A 183: Carbon Steel Track Bolts and Nuts
 - 6. A197: Cupola Malleable Iron
 - 7. A 234/A23AM: Pipe Fittings of Wrought Carbon Steel and Alloy / Rev A: Steel for Moderate and Elevated Temperature
 - 8. A 568: Steel, Sheet Carbon and High-Strength Low-Alloy / Rev A: Hot-Rolled and Cold-Rolled, General Requirements
 - 9. B 32: Solder Metal
 - 10. B 88: Seamless Copper Water Tube
- F. Copper Development Association

1.05 SUBMITTALS

- A. See Section 232000 and General Conditions for additional information.
- B. Product Data: Include date on pipe materials, steam/condensate specialties, pipe fittings and accessories. Provide manufacturers catalogue information and mill certificates.
- C. Welders Certificate: Include welder's certification of compliance with ASME (BPV IX).
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of all piping, valves, traps and valve tag numbers.
- F. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable designation.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- H. Provide piping plans to a minimum scale of 1/4" - 1'-0".

1.06 QUALITY ASSURANCE

- A. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- C. Welders: Certify in accordance with ASME (BPV IX).

1.07 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of steam and condensate piping systems including specialties.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Protect piping systems and specialties from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 ENVIRONMENTAL

- A. Do not install piping when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.
- B.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide all piping, fittings, flanges, couplings, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment as shown on the drawings and as required to provide complete systems. All piping, fittings and accessories shall conform to the appropriate Service Pipe Schedule as specified hereinafter.
 - 1. Acceptable manufacturers contingent on compliance with the specifications.
 - a. Pipe
 - 1) Steel
 - (a) U.S. Steel
 - (b) AK Steel
 - (c) Or approved equal
 - 2) Copper
 - (a) Cambridge Lee
 - (b) Cerro
 - (c) Or approved equal
 - b. Fittings
 - 1) Welded Fittings
 - (a) Anuil
 - (b) Weld Bend
 - (c) Hackney
 - (d) Or approved equal
 - 2) Iron Fittings
 - ITT Grinnel
 - (a) Flagg
 - (b) Ward
 - (c) Or approved equal
 - 3) Steel
 - (a) Vogt
 - (b) Velan
 - (c) Or approved equal
 - B. General
 - 1. All pipe and fitting shall be new, first quality material suitable for continuous operation under the conditions specified. All material shall be in conformance with ANSI Standards.
 - 2. All pipe shall be a product of the United States of America. Mill certificate shall be provided as required.
 - 3. All piping shall be clearly marked with material specification.
 - 4. All pipe and material shall comply with the requirements and recommended practices of ASME B31.1 Power Piping Code (latest Edition and Addenda).
 - 5. Elbows shall be long radius ANSI B16.9 unless otherwise specified.
 - 6. Fittings shall be used at all branch connections from headers.

7. Steam pipes shall be provided with drip legs and traps at all low points and as otherwise specified.
8. Steam service as specified herein shall include steam trap piping to and including shut-off valve on trap discharge and relief valve discharge.
9. Condensate service shall start at the connection to the main valve where the branch to the steam trap starts.
10. All pipe and fittings with threaded ends shall have IPS threads cut clean and true and in conformance with the ANSI B1.20.1.
11. Threaded pipe and fittings shall be made up with special care to avoid marring or damaging pipe and fitting surfaces.
12. All threaded joints in steel and iron pipe shall be made up with pipe thread compound or other compound suitable for design temperature and pressure of piping. All threaded joints in copper pipe shall be made up with Teflon pipe tape, petroleum gas grade, wound on male threads, clockwise as viewed from end of pipe.
13. No joints shall be "backed-off" to align pipe and fittings.
14. Gauge lines shall be stainless steel with compression fittings.
15. Piping for compressed air for controls shall be copper.

2.02

2.03 REFERENCE STANDARDS

- A. ASME B31.1 - Power Piping; 2024.
- B. ASME B31.9 - Building Services Piping; 2025.
- C. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- D. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.

2.04 SERVICE PIPE SCHEDULE

Service	Type	Grade	Wall		Joints (Minimum Sch. Shall match Wall)	
			to 10"	12" & Up	2" and Less	2½" & Up
Low pressure steam	A106 or A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded Malleable	Butt Welded
Low pressure condensate return	A106 or A53 Seamless or ERW	A or B	Sch.80	Extra Strong 0.5"	Threaded Note 1	Butt Welded
Miscellaneous drains to 2"	Hard Drawn Copper	ASTM B88	Type L		DWV 95-5 Solder	
Refrigerant system	Hard Drawn Copper ACR	ASTM B280	Type L		Silver Braze	Silver Braze

2.05 FITTINGS

- A. For Steel Pipe
 1. 2 1/2" and Larger, Butt Welded
 - a. Butt weld, same weight as piping.
 - b. ANSI A234 WPB
 - c. ANSI B16.9
 - d. Branch Connections:

- 1) Equal to main and to (2) pipe sizes smaller shall be welded tees.
 - 2) Three (3) pipe sizes and smaller than main:
 - (a) 2 1/2" and larger: weldolets or Tee
 - (b) To 2": Thread-O-Lets, sock-o-let or Tee.
 2. 2" and Smaller Screwed
 - a. Carbon Steel: A105, ANSI B16.11
 3. Mechanical Couplings and Fittings: Contractor's option to provide mechanical couplings and fittings in lieu of welded fittings and joints for water service not exceeding 150°F in exposed areas and mechanical rooms or runs above ceiling tile or drop ceiling that provide access.
- B. For Copper Tubing
1. Solder Joint: Wrought Copper, ANSI B16.22 or Cast Bronze B16.18.
 - a. 2" and less
 - 1) Silver brazing alloy.
 - b. 2½" and larger
 - 1) Silver brazing alloy.
 - (a) For refrigerant piping and where noted: Silver brazing alloy, similar to Handy and Harman Easy-Flo.
 2. Compression and Flared Fittings: Cast brass, ANSI B16.26.

2.06 UNIONS

- A. For Steel Pipe
1. Malleable iron 300 lb. Wsp
 - a. Ground Jacket Seat: Brass-to-iron, black or galvanized to match piping.

PART 3 – INSTALLATION

3.01 PIPING INSTALLATION

- A. Provide all piping systems as shown on the drawings and otherwise required to make a complete, workable and neat job, installing all valves, appurtenances, unions. The Contractor shall use care arranging all piping as shown on the drawings and shall carefully examine the arrangements where offsets are indicated and shall follow details as shown.
- B. All piping shall be run to true alignment generally parallel or perpendicular to adjacent building walls, floors and ceilings and with uniform grades and spacing so as to present a neat and workmanlike appearance.
- C. Care shall be paid to the exact locations for all piping and equipment with respect to equipment, ducts, conduits, slabs, beams and lighting fixtures, so as to provide maximum access to all mechanical and electrical equipment in the buildings. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner. The drawings and specifications covering other work to be done in the buildings shall be carefully studied and arrangements made to avoid conflict.
- D. The drawings shall be followed where they are definite and provided such procedure causes no objectionable conditions or does not conflict with other Trades, Laws, Regulations or recommendations of equipment manufacturers. The drawings are intended to indicate the sizes of piping connections and if certain sizes are omitted, or unclear, obtain additional information before proceeding.
- E. Rough in for all equipment requiring connections to the Mechanical work. Obtain all necessary data on exact locations, sizes, connections, fittings and arrangements and exact routings as may be required for proper installation.
- F. Bushings shall not be used for reducers. Reducing fittings shall be used for all changes in pipe size and shall be as follows:
 1. Horizontal water piping: Eccentric flat on top for venting.
 2. Horizontal steam and condensate piping: Eccentric flat on bottom for drainage.

3. Vertical water or steam: Concentric.
- G. Unions shall be provided in conjunction with all equipment, coils, control valves and specialties in all pipe lines and at all points necessary to provide reasonable access to the piping systems.
 - H. Ends of all pipes shall be reamed clean and all pipes shall be straightened before erection and measures shall be taken to preserve this cleanliness after erection.
 - I. Support piping independently at all equipment so that the equipment is not stressed by piping weight or expansion.
 - J. Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation.
 - K. Provide dielectric unions between dissimilar pipe materials to prevent galvanic action as required.
 - L. Provide proper provision for expansion and contraction in all portions of pipe work, to prevent undue strains on piping or apparatus connected. Provide double swings at riser transfers and other offsets to take up expansion. Arrange riser branches to take up motion of riser. Branch runouts to equipment shall have a minimum of (3) elbows, adequately spaced.
 - M. All piping connections to equipment shall be made with offsets. Provide with unions, grooved joint couplings and/or flanges so arranged that the equipment can be serviced or removed without dismantling the piping. If equipment, when commissioned, becomes air bound or stratified, all necessary modifications to the piping system required to rectify the condition permanently shall be made to piping and equipment, furring, floors, walls, etc., at the Contractor's expense.
 - N. Pipe pitch, unless otherwise indicated on the drawings, shall be as follows:
 - 1. Steam and condensate: 1" in 40'-0", down in direction of flow.
 - 2. Steam riser branches and undripped connections: 1" in 10'-0", up in direction of steam flow.
 - 3. Condensation Drainage:
 - a. Preferred: 1/4 inch./ft., down in direction of flow.
 - b. Minimum: 1/8 inch./ft., down in direction of flow.
 - O. Drain connections at low points in water piping and where noted:
 - P. Copper tubing and galvanized steel shall not be mixed in any one run of piping, except as otherwise specified herein.
 - Q. During construction, temporarily close open ends of pipes with sheet metal caps or duct tape to prevent debris from entering piping systems.
 - R. At low points of steam lines provide traps adequately sized to collect condensate. All supply mains shall be dripped and trapped on any vertical lift. Provide capped full sized dirt pockets at all traps, riser heels, and wherever dirt and scale may accumulate. To meet job conditions, mains shall be set up (with drip connections to return line) to maintain headroom and clear other pipes as hereinbefore specified.
 - S. Joints in piping systems, for all services, shall be made tight and leakproof against test pressures. Leaks in screwed or flanged joints which cannot be eliminated by normal wrench tightening methods shall be repaired at the joint. Under no circumstances shall caulking be allowed. No joints shall be backed off to align pipe fittings.
 - T. Refrigerant Piping and Connections
 - 1. Provide all refrigeration piping, including thermal expansion valves, driers, moisture indicator sight glasses, shutoff valves, controls, gauges, insulation and other appurtenances, as required to complete the refrigeration system. Piping connections to the units shall be fitted with flexible pipe fittings and renewable unions.
 - 2. The HVAC Contractor shall triple evacuate and field charge entire refrigeration system. All labor and materials required for evacuation, charging, as well as commissioning of the refrigerant systems, shall be provided by the HVAC Contractor. The refrigerant piping

arrangement shall be in strict accordance with manufacturer's recommendations. Provide shop drawings indicating sizes and all required components and accessories for Architect's review prior to ordering equipment or installation.

3. All refrigerant piping exposed to weather outside the building shall be properly supported in a manner to allow expansion and contraction. All sleepers provided shall be secured and their installation shall be as directed and approved by the Architect.
4. Refrigerant piping joints shall be made with cadmium free 45% silver brazing filler metal having a melting point of 1225°F. Joint flux, if used, shall be compatible with materials. The outside surface at end of pipe and inside surface of fittings shall be thoroughly cleaned with steel wool or emery cloth, and cut pipe ends shall be reamed and all burrs shall be removed. Care shall be taken to ensure the entry of foreign particles into the system does not occur. While brazing, purge piping with low pressure nitrogen to prevent interior oxidation and to dry the system. Caution must be taken to continuously ventilate the work area and to avoid allowing nitrogen to concentrate in an enclosed area thereby expelling all of the oxygen and causing asphyxiation.
5. Traps shall be factory fabricated one-piece fittings or field assembled 45°-90°-45° elbows. Do not use 90°-90°-90° elbows.

3.02 WELDING

- A. All welding done under this Contract shall be performed by experienced welders in a neat and workmanlike manner. All welding done shall be in accordance with ASME B31.1 Power Piping Code (latest Edition and Addenda). The Contractor shall furnish to the Owner for approval and record the following:
 1. Welding Procedure Specifications (WPS) for each procedure to be used
 2. Procedure Qualification Record (PQR)
 3. Welding Operator Qualification Tests (WPQ) for each welder to be employed.
- B. Documents shall be on forms similar to the forms referenced in the ASME Boiler & Pressure Vessel Code, Section IX, latest edition. These records shall be furnished to the Owner for this project not less than (2) weeks, prior to any welding. All welders to be employed by the Contractor on this work shall be certified in accordance with the above. The Mechanical Contractor shall test welders to these procedures within (3) months of the work beginning to certify them for this work. The above forms shall be clearly marked specifically for the Contractor's use and certified by the appropriate personnel. Documents prepared for other's use are not allowed. Failure to provide these forms to the satisfaction of the Owner, or his representative, will result in the replacement of the Mechanical Contractor with one who can meet these requirements, at no additional cost to the Owner. No delays or cost increases to the overall project schedule will be accepted due to non-compliance with the above by the Mechanical Contractor.
- C. Mitered elbows are not permitted. Odd angle elbows shall be cut from long radius elbows.
- D. The weld reinforcement shall be not less than 1/16" nor more than 1/8" above the normal surface of the joined sections. The reinforcement shall be crowned at the center and shall taper on each side to the surface being joined. The exposed surface of the weld shall present a workmanlike appearance and shall be free of depressions below the surface of the joined members.
- E. No welding of any kind shall be done when the temperature of the base metal is lower than 50°F. Material to be welded during freezing temperatures shall be made warm and dry before welding is started. Temperature of metal shall be "warm to the hand", or approximately 60°F.
- F. Welds will be inspected visually by supervisory representatives of the Architect and the Contractor. Any weld judged defective by the Architect from a visual inspection shall be cut out and tested in the presence of the Owner or his representative. In the event any welder consistently produces a high percentage of unsatisfactory production welds, he shall be discharged at the request of the Owner, even though he is able to produce satisfactory welds when especially tested. Removal and replacement of test coupons and samplings shall be

done at the expense of the Contractor. The Owner reserves the right to ultrasonically or radiographically test any welds for full penetration.

- G. Paint all external surfaces of welds with a high temperature paint prior to insulation being applied.
- H. Store all 7018 electrodes in rod oven once original container is opened.
- I. Welds in all high pressure steam and high temperature hot water (350°F or greater) shall be X-ray tested. This X-ray shall be performed by an independent testing company. Testing company shall employ certified weld inspectors. The welds shall meet the X-ray requirements in ANSI B31.1. The independent inspection services shall be provided by the Mechanical Contractor.

3.03 CLEANING AND BLOWING OUT

- A. The equipment and piping installed under this Section shall be blown out under pressure and cleaned of foreign matter, through temporary connections where necessary, before the system is placed in service. Super heated high pressure steam piping shall be blown out following ASME procedures. Precautions shall be used to prevent foreign matter from getting into equipment and piping during construction. The supplier of water treatment equipment and chemicals shall recommend and furnish chemicals for the purpose of cleaning and blowing out of all systems. All chemicals, materials, instruments and labor shall be provided by the Contractor.
- B. The surfaces of all equipment and piping shall be clean upon completion of the work.
- C. All pipe line strainers shall be cleaned immediately before being turned over to the Owner for acceptance.
- D. During cleaning process, hammer welds to remove scale, weld slag and other debris.

3.04 TESTING

- A. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of the tests herein specified. Correct all defects appearing under test and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.
- B. Perform all tests other than herein specified which may be required by Legal Authorities or by Agencies to whose requirements this work is to conform.
- C. Furnish all necessary testing apparatus, make all temporary connections and perform all testing operations required, at no additional cost to the Owner.
- D. All equipment and piping installed under this Contract shall be tested and found tight. Insulated or otherwise concealed piping shall be tested before being closed in. All leaking joints shall be corrected, retested and found tight. Such tests shall conform to the requirements of Local Codes but shall not be less than the equivalent of the tests called for herein. Threaded joints that leak shall not be seal-welded to correct leakage.
- E. Tests performed shall not relieve the Contractor of his responsibility for leaks which may develop after the tests are made.
- F. All piping systems shall be subjected to a hydrostatic test at 1 1/2 times operating pressure measured at the highest point in the system, for a period of (4) hours without drop in pressure. All oil piping shall be subject to a test with oil at 1 1/2 times operating pressure for a period of (4) hours without drop in pressure.
- G. Tests of piping systems shall be conducted before connections to equipment are made and before piping is covered, buried or otherwise concealed.
- H. Systems found to have leaks shall be subjected to further tests when faulty joints have been repaired or replaced.

- I. Welded joints shall be subjected to a hammer test while under pressure.

END OF SECTION 23 20 00 23 20 00