

SECTION 232114 PIPING MATERIALS INSTALLATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section gives the general requirements for the piping materials and field fabrication, installation, testing, and placing into operating condition the various piping systems shown on the contract drawings for the project. The detail requirements for each piping classification are given in specification 232113 "Hydronic Piping." These specifications give the minimum material requirements for the project and the materials for all work on the project shall conform to these specifications. When there is conflict between drawings and this specification, the Contractor shall resolve the same with the Engineer.
- B. Furnish and install pipe, fittings, and joining materials for use with the piping systems described within this Section and as shown on the contract drawings.
- C. Furnish and install piping and piping specialties.
- D. Piping classifications are listed in the Piping Service Index in specification 232113. Unusual conditions for each detail specification are covered by notes within the specification and these are to be followed where applicable.
- E. Contractor to furnish and install permanent labels on all piping installed under this contract. Labels shall be placed at each point of connection to equipment. When piping runs through a wall or roof, place a label on each side within ten (10) feet of penetration. Labeling shall be in accordance with specification 230553 unless directed otherwise by these specifications and/or the Engineer.

1.2 SPECIAL REQUIREMENTS

- A. All elastomeric full flange face type gaskets such as neoprene, Viton, and rubber shall not extend beyond the inside diameter nor the outside diameter of the flange when fully compressed.

1.3 RELATED WORK

- A. Piping & Valves Materials Specification.
- B. Pressure Testing of piping Assembly Specification.
- C. Pipe Hangers, Supports, Guides and Anchors Specification.
- D. Protective Coating –Painting Specifications.
- E. Piping Insulation Specification.

1.4 SUBMITTALS

- A. Field Test Report - Submit records of pipe system testing and examination to the General Contractor for record.
- B. The Piping Contractor shall submit in writing, the following forms and Documentation to the General Contractor prior to commencement of construction:
 - 1. Welding Procedure Specifications (WPS's).
 - 2. Procedure Qualification Records (PQR's).
 - 3. Welder Performance Qualifications (WPQ's) for all personnel who will weld on this project (both in the field and at the shop).
- C. Submit other documentation in accordance with the applicable Code or Standard and this specification.

1.5 QUALITY ASSURANCE

- A. All materials, design, fabrication, assembly, and test procedures shall be in accordance with the applicable requirements of all applicable codes, standards or regulations having jurisdiction over the work.
- B. The organizations having jurisdiction include, but are not limited to, the following, as well as those identified in specification 230500:
 - 1. ASME B31.1: Power Piping.
 - 2. ASME B31.3: Chemical Plant and Petroleum Refinery, Process Piping.
 - 3. ASTM: See Part 2 (Products) of this Section for specific material standards.
 - 4. ASME: See Part 2 (Products) of this Section for specific material standards.

PART 2 - PRODUCTS

2.1 PIPING MATERIAL AND FITTINGS SPECIFICATIONS

See Piping Materials Specification no. 232113.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. The piping shall be erected as shown on the drawings and connected as shown at points of attachment on equipment. In-line items of equipment and instruments such as strainers, filters, separators, orifice flanges, steam traps, flexible connectors, gaskets, etc., shall be treated as piping items and shall be furnished and installed by the Contractor in strict accordance with the manufacturer's requirements. Before, during and after erection, all piping systems shall be protected to prevent rusting or other damage until final acceptance by the Engineer.
- B. Unless shown otherwise, route piping in the most direct manner, parallel to building lines. Where the drawings indicate a pipeline slope, the slope is to be uniform between the established elevations and without pockets.

- C. Close open ends of piping, when it is not actually being worked on, with flange covers, caps or plugs to prevent entry of foreign material during construction. The Piping Contractor shall exercise care in hauling material from storage area to position for erection to prevent dislodgement of the covers, caps, plugs, etc., until ready for installation. Clean all piping, including the reworked existing piping, before installation/joints are made to remove grease, loose dirt, mill scale and other foreign material.

During installation, all covers, caps, plugs, etc., on piping shall remain in place until removal for fit-up is required.

- D. Temporary pipeline strainers shall be provided and installed by the Contractor in the suction of each pump and compressor prior to flushing and testing. Use basket or conical type (similar to Mueller Models 22 or 23) with perforated and/or mesh lined material for retention of particles as follows:

Line Size	Air Service	Gas Service
1/2" to 2"	1/16"	1/32"
2-1/2" and up	1/8"	1/16"

The pipeline in which the strainer is included shall be fitted to dimensions considering the temporary strainer removed. When a temporary strainer is to be replaced by a permanent strainer, the permanent strainer shall be furnished and installed at the conclusion of flushing and testing. Where no strainer is used, the temporary strainer shall be removed and the "spool piece" reinstalled.

- E. Accurately align, support, and connect piping without springing or forcing. Cutting or weakening of structural members to facilitate piping installation shall not be permitted.
- F. Locate piping so that access to and clearance around equipment, and minimum piping headroom of seven (7) feet are maintained, except where otherwise shown.
- G. Space piping so that insulation and flanges, if any, have at least 1 inch clearance after maximum movement. Piping headroom of seven (7) feet shall be maintained except where otherwise shown.
- H. Where pipe elevations are not shown, pitch supply and return lines to positive drain points and/or coils.
- I. Provide accessible flanges or union connections on the supply and return connections of terminal equipment and other items, which must be disconnected for maintenance. Where unions are furnished as an integral part of the equipment, additional unions are not required. Arrange equipment, piping connections so that maintenance can be made without removing large sections of pipe or relocating the equipment. Fit-up of connecting pipe to equipment shall be such as to impose no strain on the pipe or equipment. Upon breaking of unions or flanges, there should be no visible end or side movement or rotation of the pipe with relation to the mating flange.
- J. Where a well or control instrument is to be installed in piping 2-1/2 inches and smaller, increase the pipe size by at least one pipe size to avoid restricting the flow in the pipe.

- K. In Water Systems, connect branch lines to the top of the line. All other liquid systems, connect branch lines to the bottom or lower half of the line, unless shown otherwise on the drawings.
- L. Connect branch lines in steam and compressed air service to the top or upper half of the line, preferably the top. Follow manufacturer's guidelines and contract drawings for branch take-offs of vacuum cleaning lines.
- M. Do not use pipes smaller than 1/2 inch except for instrument control.
- N. For pressures over 15 psig, use nipples and caps instead of plugs for permanent closures. Plugs in equipment provided by the equipment manufacturer are acceptable.
- O. Dielectric fittings shall be provided where nonferrous piping is connected to ferrous piping or equipment.
- P. Valved vents at all high points and valved drains at all low points shall be provided for all piping systems, except for air and gas services, to satisfy system flushing and draining requirements. Locations shall be determined by the Contractor and approved by the General Contractor.
- Q. Flanged joints shall be kept at minimum required for erection or as may be required for maintenance and/or inspection.
- R. All piping shall be installed to permit free expansion and contraction without damage to joints or supports.

3.2 MATERIALS RECEIVING AND STORING

- A. All materials for completion of the project, including material furnished under other sections of the work shall be received, unloaded, and hauled to the site by the Contractor.
- B. Piping materials, including valves, fittings, and instruments, shall be handled and stored so as to prevent damage.
- C. All materials shall be stored in areas designated by the General Contractor and transported from the storage area to the point of installation as required.
- D. Special care shall be taken to prevent detachment of identification tags from pipe and fittings and code numbers from valves.

3.3 WELDED CONNECTIONS

- A. Pipe fabrication and welding shall be in accordance with ASME B31.1 and ASME B31.3.
- B. All welders for pipe fabrication must be certified as qualified for the work specified by means of valid papers and tests prior to performing any welding. Qualifications of welders, welding procedures performance of welders and welding operators shall be as required and shall comply fully with the requirements of ASME B31.1, ASME B31.3,

ASME B31.9, ASME Boiler and Pressure Vessel Code: Section IX - Welding and Brazing Qualifications, and AWS D10.9.

- C. The Contractor shall submit, for approval by the Engineer, the name or names of a competent welding supervisor normally engaged in welding control on a staff basis. The Contractor will also submit a copy of all welders' certification papers and tests. The Contractor will submit to the Engineer and receive the Engineer's approval for the welding techniques and procedures prior to the initiation of any work, welding or otherwise. All procedures to be used for welding the various classes of piping shall be qualified in accordance with ASME Section IX.
- D. Provide single-vee type butt welds, unless specified otherwise, in accordance with approved procedures.
- E. Whenever welding is done close to walls, floors or building structure, thoroughly clean the surfaces of weld splatter.
- F. Mitered welds for elbows are not allowed.
- G. The distance between finished edges of adjacent circumferential welds shall not be less than the diameter of the pipe.
- H. Do not expose any plastic piping to excessive heat or weld spatter.
- I. Examine and inspect welded pipe joints as follows:
 - 1. All welded pipe joints shall be visually examined for imperfections by qualified representatives of the Contractor.
 - 2. A record of such examinations shall be made available to the Owner and the General Contractor.
 - 3. Imperfections revealed by examination shall be evaluated in accordance with the criteria in the specified code(s) ASME B31.1 and/or B31.9.
 - 4. Shop and field welded joints will be subject to nondestructive inspection and examination by the Owner or an authorized inspector designated by the Owner in accordance with the requirements of the appropriate sections of the applicable ASME Code for Pressure Piping B31.1 and/or B31.9, and the engineering design.
 - 5. Remove weld defects by grinding or chipping and repair or replace weld joints in accordance with approved procedures.

3.4 WELDING ELECTRODES

- A. All electrodes for manual arc welding of steels shall be of heavily flux-coated type, conforming to the requirements of AWS Specifications. The selection of particular grades shall be subject to the approval of the General Contractor.
- B. Electrodes and filler metal, used in all other welding processes, shall meet the requirements of applicable AWS Specifications. The brand shall be subject to the approval of the General Contractor.
- C. Welding electrodes shall be selected from the following tables:

Materials to be Welded	Electrode Deposit Composition
Carbon Steel to Carbon Steel, Steel or Carbon Moly	Carbon Steel
Carbon Moly to Carbon Moly	Carbon Moly
Chrome-Moly to Chrome-Moly	Ferritic Chrome-Moly con- taining at least as much Cr and Mo as lowest Cr and Mo in base materials being welded (1)
Chrome-Moly or Carbon Steel to Austenitic Steels	AISI Type 309 or 310
AISI Type 304 to 304 or other Austenitic Steels	AISI Type 308
AISI Type 304L to 304L	AISI Type 308L (2)
AISI Type 347 to 321	AISI Type 347
AISI Type 316	AISI Type 316
AISI Type 316L	AISI Type 316L (2)
Carbon Steel, Austenitic Steels or Types 405 and 410	AISI Type 309 or 310
Monel Monel	Monel (Special low Carbon coating)
Monel to Steel Ferritic Nickel Alloy Steels	Ferritic nickel alloy rod containing at least as much nickel as the base material (1)

Notes:

1. These electrodes are to be used for all butt welds unless the use of austenitic AISI Type 308 or 310 electrodes is specially permitted or designated by the Engineer. For other welds, however, such as front and back welding, of screwed or slip-on flanges, thermocouple wells, test hole fittings, etc., AISI Type 310 or 309 austenitic stainless steel electrodes shall be used in all cases.
2. When the base materials are specified as extra low carbon material, the welds deposits shall be extra low carbon (0.04 C max.) or columbium or columbium-tantalum stabilized.
3. Electrode deposits, differing in analysis from the metals, which will improve weldability, may be used if prior approvals, in writing, are obtained from the Engineer.

3.5 TESTING AND EXAMINATION OF WELDS

- A. Nondestructive testing of piping will be performed as required by ASME B31.1, ASME B31.3, and as discussed herein. Nondestructive testing will generally include visual, radiographic, magnetic particle and liquid penetrant and ultrasonic examinations.
 - 1. Personnel qualified and certified in accordance with AWS QC1, Standard Qualification and Certification of Welding Inspectors will perform visual examination of all welds. In addition, the inspector shall, at appropriate intervals, do sufficient examination of materials, joint preparation, fit-up, root passes, filler passes, welder performance, etc. to assure that the applicable requirements of the code are met. In short, all aspects of the process get spot checked throughout; all welds get a final look. The in-process examination cannot be ignored or omitted; final inspection is not a substitute.
 - 2. Fuel oil, demineralized water and high-pressure hydraulic piping welds are 10% x-ray inspected. Other piping welds are randomly x-rayed.
For natural gas piping all 100% of both shop and field welds shall be tested by radiography, including Owner's or Project Developer furnished valve train assemblies. Personnel qualified and certified to meet the requirements of ASME B31.1 shall perform radiographic examination of welding. All defective welds, except for those found on Owner/Engineer-furnished valve train assemblies, shall be reworked and radiographically reexamined at the Contractor's expense. All defective welds found on Owner/Engineer-furnished valve train assemblies shall be reworked and radiographically reexamined at the direction of the General Contractor. All shop weld inspections and examinations will be performed prior to final placement in the field.
 - 3. Magnetic particle and liquid penetrant examination will be performed as required by the applicable code.
 - 4. Ultrasonic tests will be performed as required by the applicable code.
- B. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with applicable codes.
- C. The Contractor shall submit a description of their Quality Control Program and the qualifications of their inspection personnel. The Contractor shall make available to the General Contractor documentation of the Contractor's CWI Reports on all welds.
- D. The Contractor shall submit as part of their written Quality Control Program, minimum code inspection requirements. These shall be distributed and reviewed by all certified welding personnel (both in the field and at the shop) so they are aware of the inspection criterion to which they will be held accountable.

3.6 FLANGED CONNECTIONS

- A. Flange bolt holes shall straddle the pipe vertical and horizontal centerlines, and shall match the orientation of mating flanges, unless otherwise noted on the contract drawings.
- B. Thread sealant suitable for service shall be used on gaskets, flange faces, bolts, studs, and nuts, such as a graphite and oil mixture anti-seize compound.

- C. Remove the bolts in flanged connections or disconnect piping after the installation is completed to demonstrate bolt hole alignment and fit, if requested by the General Contractor.
- D. Flanges shall be aligned, and bolts torqued evenly as required, sealing the gaskets and providing uniform stresses in the bolts. Gaskets at all flanged connections suitable for the design pressure and temperature of the fluid contained, and in accordance with the attached Piping Material Specifications. Installation shall be in accordance with the gasket manufacturer's recommendations.
- E. Flanges shall have matching faces. Where a flat-face flange and a raised-face flange must be bolted together, machine the raised-face flange flat and use a full-face gasket between the flanges. Raised-face flanges are not permitted for mating with non-metallic flanges.
- F. No flanged joint shall be made up if misalignment exceeds the following limits:
 - 1. Alignment - Flange facings shall not be more than 3/64" per foot, measured across any diameter, out of line.
 - 2. Lateral Displacement - The lateral distance between the center of the flanges shall not exceed 1/8" in any direction.
 - 3. Rotation - The distance between any two mating bolt holes, after one pair of mating bolt holes has been lined up shall not exceed 1/16".
- G. Care shall be exercised in tightening of non-metallic joints to avoid over-tightening and deformation of flanges. Use fiber or metal spacers to eliminate any gaps. Flat washers shall be used under the bolt heads and nuts on all non-metallic flanges.
- H. On stainless steel piping or tubing systems where lap-joint flanges are permitted, flanges and bolting shall be stainless steel in any area where high humidity or corrosive fluids are expected.

3.7 THREADED CONNECTIONS

- A. Care shall be exercised to ensure that field threaded pipe is accurately cut and threaded. Seal welding of leaking joints due to improper threading will not be permitted. Leaking joints shall be disassembled and remade with correctly threaded pipe and fitting. Pipe dope is not a substitute for properly made threaded joint. The dope acts as a lubricant only.
- B. Where back-welding of screwed joints is specified, no dope or lubricant shall be used.
- C. Piping for all systems shall be installed using thread sealant suitable for service. Sealant shall be used on all pipe threads. If connection is to be seal-welded, a joint compound or sealing tape shall not be used.
- D. Where the drawings or specifications so indicate, screwed joints for attaching valves or other permanently connected equipment shall be installed with Teflon Ribbon tape on the pipe threads as appropriate for its service conditions. Apply to male threads only. Conceal threads on chrome-plated pipe.
- E. Ream pipe ends to remove burrs.

- F. Use only standard taper threads per ASME B1.20.1. Threads shall be full, sharp, clean, and free of fins and burrs.
- G. Do not use close or short nipples of a size where the length of unthreaded pipe is less than the width of a pipe wrench.
- H. Threadolets or similar code-approved fittings may be used for branch connections. Branch connectors are permitted to be one pipe size smaller than the main or branch main.
- I. Slip joints will be permitted only in Sanitary Drainage Systems on the fixture side of traps.
- J. Backing off of made-up threaded connections to facilitate fit-up or alignment is not permitted.
- K. On steel and copper lines under vacuum or instrument air service, cutting thread lubricant shall be soap and water. These lines shall be oil free.

3.8 VALVES

- A. Valves shall be of the same size as the pipe in which they are installed, unless shown otherwise on the contract drawings.
- B. Install valves with the stem on or above the horizontal. Install valves with the stem horizontal if requirements of headroom, access and chain operation must be met.
- C. Valves shall be packed, and glands adjusted before final acceptance.
- D. Install valve extension stems or chain operators where the center of valve handwheels is more than 6 feet-6 inches above the floor, or as indicated otherwise. Provide chain hooks where required to prevent fouling of chains on equipment and to clear walkways. Terminate chains approximately 3 feet-6 inches above the floor. Provide worm gear operators or impact handwheels for all valves 6 inches and larger. Impact handwheels and chain operators shall be Babbitt Steam Specialty or approved equal. Chain operators are not required on valves 2 inches and smaller, and on valves with threaded ends.

3.9 CONNECTIONS OF DISSIMILAR METALLIC MATERIALS

- A. Isolate connections between dissimilar metallic materials. Use dielectric fittings or nipples that provide a complete isolation of the two ends using materials suitable for the design pressure, temperature and fluid contained.

3.10 IN-LINE INSTRUMENT AND RELATED PIPING

- A. Install all in-line instrument as specified on P&ID drawings which may consist of pressure regulators, control valves, solenoid valves, rotameters, vacuum breakers, etc.
- B. Pressure Gauges: For metallic lines, furnish and install a 1/2" full coupling in the pipe and 1/2" ball valve. For plastic lines 6" and larger, use a 1/2" x 1" threaded reducing

bushing, and a 1/2" plastic ball valve. For plastic lines 4" and smaller, use socket reducer inserts on a straight size "T". Instruments shall be supplied and installed by Others.

- C. Temperature Sensor: For all metallic pipelines, furnish and install a 3/4" full coupling in the pipe for pipe sizes 4" and larger. For 2" and 3" pipe, furnish a 3/4" full coupling in an elbow facing the flow of fluid. Below 2" pipe, expand pipe to a 2" elbow or a tee and provide a 3/4" female NPT connection for the thermowell. For all plastic lines, use reducing bushings to reduce the size down to 3/4" NPT connection.
- D. Pitot Tubes: Install special 1" or 2" weldolet supplied with the instrument.
- E. Restricting Orifices: Install restriction orifices. Furnish a temporary gasket between flanges for pressure testing of the pipe.
- F. The Contractor shall ensure that all valves are installed correctly in the line relative to flow direction.
- G. The Contractor shall ensure that all automated valves stroke smoothly with the correct packing fitted.

3.11 SYSTEM FLUSHING AND CLEANING

- A. Flushing - The finished piping shall be flushed on the inside and cleaned on the outside in order to remove all loose scale, weld splatter, sand, and foreign matter. The Engineer shall approve flushing methods. Flushing shall be witnessed by the General Contractor and shall be done in accordance with the following procedures:
 - 1. All piping systems that require hydrostatic testing shall be flushed with clean water to the satisfaction of the General Contractor.
 - 2. All piping systems that require pneumatic testing shall be blown free of dirt and debris with clean, dry air to the satisfaction of the General Contractor.
 - 3. The Contractor shall provide temporary strainers with a minimum of 40 mesh screen, as necessary, to perform flushing work. Special care shall be directed toward thoroughly flushing piping to any equipment which may be damaged in any way due to entrance of foreign matter, such as burners.
 - 4. Flushing shall be complete when water or air samples taken at all low points indicate clear discharge - no visible solids. If not clear, continue flushing and sampling until discharge is clear.
 - 5. When flushing has been completed, lines shall be drained, permanent strainers shall be cleaned and replaced, and any temporary strainers, connections, valves, or related items shall be removed.
 - 6. Water shall be supplied by the Owner and drained to the nearest floor drain or drain trench in a controlled manner to avoid potential flooding of the facility as directed by the General Contractor.
 - 7. The Contractor shall provide system-flushing records in a manner that is approved by the Engineer and General Contractor.
- B. Cleaning - The finished piping shall be cleaned on the outside in order to remove all loose scale, weld splatter, sand, and foreign matter. In addition, piping that will be painted shall be cleaned (as required) with acetone or other suitable cleaning agent, etc., for surface preparation in accordance with the paint manufacturer's requirements.

3.12 PRESSURE TESTING

- A. Piping systems shall be pressure tested hydrostatically. Flushing and cleaning requirements shall be completed prior to pressure testing. Testing shall be done in accordance with the following procedures:
1. Before testing, complete each pipeline including supports, hangers, and anchors. Perform testing before insulation or paint is applied. Clean piping and equipment of metal cuttings and foreign matter as they are installed.
 2. Submit test procedures and schedules to the General Contractor before testing starts. The Engineer and General Contractor shall approve test procedures and schedules. All tests shall be witnessed and approved by the General Contractor.
 3. Codes - Pressure test piping to assure integrity of material and workmanship in accordance with the applicable ASME Code for Pressure Piping, B31.1.
 4. Test the piping in sections or circuits as required for the progress of the work.
 5. Systems to be pressurized shall be provided with appropriate gauges and pressure-relieving devices.
 6. Test pressure readings may be taken at the lowest point in the line or system of lines, provided that the static head is added to the minimum test pressure.
 7. The General Contractor may waive a pressure test for any reason. Such waiver shall be noted on the pressure test report.
 8. Duration of Test - Maintain the test pressure for a sufficient time as identified in specification no. 230592 to determine and locate any leaks.
 9. Records - Provide a record of all tests. The record shall show line number, test pressure, ambient temperature, date of test, retest, and signature of General Contractor. If either testing or witnessing is waived, a note shall be made for each line so waived. Contractor shall submit the Piping Pressure Test Report for Engineer's review.
 10. Repair of Line Leaks - Comply with the following procedures for repair of leaks. In each case, a retest shall be necessary after repairs are made and shall be made at no additional cost to the General Contractor.
 - a. Soldered/Brazed Joints - Remove solder/brazing alloy and reapply with proper flux.
 - b. Flanged/Grooved End Joints - Check to determine flange/grooved end alignment and that all bolts are uniformly tightened with the required torque. If the leak persists, depressurize the line, remove the gasket, examine flange/grooved end faces, and insert new gasket.
 - c. Threaded Joints - Tighten joint to a reasonable torque. If the leak does not stop, replace the pipe and/or fittings. Do not use the pipe dope or cement to stop pipe leaks.
 - d. Caulked Joints - Remove the existing caulking and recaulk.
 - e. Gasketed Joints - Remove the existing gasket and insert a new gasket.
 - f. Welded, Solvent-Welded and Heat-Fusion Welded Joints - Replace joint.
 - g. Leaks in Material - Leaks located in the pipe material shall require the replacement of that section of pipe or fitting and repeat of the test from the beginning. Caulking, welding, or epoxy is not permitted. Repair all

damage caused by leaks. Repairs and retest shall be made at no additional cost.

3.13 IDENTIFICATION OF PIPING

Identification shall be in accordance with Specification No. 230553.

END OF SECTION 232114