NCPWB/MCAA

Basic Model Piping Specification

Suitable for hydronic piping and similar
steam, hot and chilled water applications

1. Scope

1.1. This specification provides the requirements for materials, fabrication, installation, examination, testing, quality control and documentation of piping systems for the Owner, (*insert owner company's name here).*

1.2. The requirements of this specification shall be superseded by the requirements shown on (Insert Engineering Organization's Name here) drawings and the requirements of the applicable piping Code. In the event of conflict between this specification and the applicable piping code, the Contractor shall advise (Insert Engineering Organization's Name here) in writing of such conflict so that the conflict may be addressed.

Commentary: This paragraph establishes the basic requirements but provides a mechanism for the Engineer to add specific requirements that may be needed on certain systems or portions of systems.

1.3. This specification contains the general requirements for all piping systems. The specific requirements for individual piping systems, including materials, sizes, schedules and classes for pipe, fittings, flanges, plates, bolts, gaskets, temperature and pressure limits, and other requirements are contained in the Piping Class Sheets and on the layout drawings for each system. Class Sheets are referenced on individual piping system drawings for each piping system, establishing the specific requirements for that system. Piping system drawings provide the system layout and also the pipe sizes to be provided. Requirements shown on drawing supersede the requirements of this specification

1.4. Whenever a Code, Standard or other published document is referenced in this document, the edition that is mandatory for the contract shall be the latest edition that was in effect on the date of contrac unless a specific edition is shown in the specifications.

Commentary: This paragraph eliminates the need to constantly refer to the edition and addenda of codes and standards throughout the specification. In addition, it provides for the use of the most recent and up-to-date versions of codes and standards. Finally, it fixes the editions to those that were current as of contract date.

1.5. The Contractor/Installer shall furnish all piping, fittings, flanges, valves, and other piping components shown on engineering drawings. Contractor shall install the piping components, including attaching lugs, clips, plates, etc. needed to install the piping in accordance with the engineering drawings. The Contractor shall perform all inspection and nondestructive examination required by the applicable code, this specification and engineering drawings.

2. Definitions

2.1. Owner

The term Owner shall mean (insert the Owner's Name here)

2.2. Contractor

The organization that has bid on work or has received a contract to perform work for the Owner.

3. Technical Requirements

3.1. Applicable Codes and Standards

3.1.1. All piping which is within the Scope of the ASME Boiler and Pressure Vessel Code, Section I (Boiler External Piping) shall be installed by an organization that has a valid Certificate of Authorization from ASME (PP, S or A Stamp).

3.1.2. The materials, fabrication, installation, examination and testing of all piping systems shall be in accordance with the requirements of (Engineering Organization to check ONE of the following for the overall job):

☐ ASME B31.1, Power Piping

☐ ASME B31.3, Chemical Plant and Petroleum Refinery Piping
☐ ASME B31.5, Refrigeration Piping
☐ ASME B31.9, Building Services Piping

3.1.3. When B31.3 is specified, the piping shall be considered normal fluid service, except where the Piping Class Sheets or the Engineering Drawings designate the piping to be Category M, High Pressure, severe cyclic, high purity or Category D. When engineering drawings specify a different B31 code section that checked above, the B31 section specified on such drawings shall apply to the piping on that drawing.

Commentary: Clearly specifying which B31 Code Section is applicable is necessary since there is overlap in the scopes of the respective Codes. For a detailed description of the scopes of the B31 piping codes, search on "Selecting B31 Scope" or click on:

cstools.asme.org/csconnect/FileUpload.cfm?View=yes&ID=22855 .

4. Design

4.1. The design of piping systems, including pressure design, thermal stress analysis, dead weight design, support design and location, hydraulic transient design and selection of materials is the responsibility of the Owner's or his Engineer in accordance with the requirements of the applicable code and good engineering practice.

Commentary: On engineered piping systems, design of a piping system, including its support and restraint, is generally the responsibility of the engineer.

4.2. The Contractor may elect to fabricate branch connections in lieu of using tees when tees are specified on the Piping Class Sheets. In this case, the Contractor shall submit area replacement calculations as required by the applicable B31 Code Section for review and acceptance by the Engineer. Use of fabricated branch connections will not be permitted for Category M service. Fabricated branch connection may not be acceptable in certain situations due to the increased stress intensification factors which are required for such connections when compared to tees; such situations will be so identified on the engineering drawings.

Commentary: The use of fabricated branch connections is frequently less expensive than the used of Tees, and, provided the Contractor performs the Code-required calculations needed to determine whether or not a reinforcing pad is required, use of fabricated branch connections should be permitted. The engineer is responsible for determining whether or not additional reinforcement is required due to external loading conditions: this may require the use of reinforcement where simple pressure considerations may not require reinforcement.

5. Fabrication and Installation

5.1. Piping shall be fabricated and installed in accordance with the Owner's Engineering Drawings. When there is a conflict between the requirements of the Owner's Engineering Drawings and other hardware, the Contractor shall advise the Owner in writing.

5.2. The dimensions of shop-fabricated piping shall be as shown on the Contractors piping subassembly drawings which shall be prepared in accordance with Pipe Fabrication Institute (PFI) Standard ES-2.

5.3. Bending techniques and tolerances on completed bends shall be in accordance with PFI Standard ES-24. Austenitic stainless steel piping which has been heated above 800 degrees F for bending shall be solution heat treated after bending.

5.4. Weld end preparations for shop welds shall be in accordance with the Contractor's shop practices. Field weld end preparations shall be in accordance with PFI Standard ES-1 or ES-21 as specified on the Piping Class Sheets. When PFI Standard ES-1 is specified, the Contractor shall provide backing rings of the type shown on the Class Sheets.

Commentary: Weld end preparations for shop welds are best left up to the Contractor. The Engineer, on the other hand, is responsible for being sure that weld end details, including counterbore on heavy pipe, is suitable for field welding techniques and compatible with all equipment supplied by other parties (e.g., valves, tanks, pumps, heat exchanger, etc.).

5.5. Welding and Brazing Procedure Specifications and welder/brazer qualification shall be in accordance with ASME Section IX as invoked by the applicable B31 Code Section. Engineering drawings or piping class sheets may specify specific welding and brazing filler metals to be used on specific piping systems or joints. In this case, the requirements of the drawing or class sheet shall be met.

Commentary: While Section IX does not specify what welding electrode or filler metal to use for any base metals, the B31 codes specify default requirements for weld metal. These requirements generally are for the tensile strength of the filler metal to equal or exceed that of the weaker of the base metals being joined and for the nominal composition of the filler metal to match that of the base metal. Since there may be situations when the engineer may choose to use other criteria, the B31 code sections allow him that option.

5.6. Low-hydrogen coated electrodes, including stainless steel and nickel alloy electrodes, shall be stored in holding ovens at 200 to 400 degrees F. after their shipping containers have been opened. Low-hydrogen electrodes shall be distributed in quantities such that they are consumed within the time limits shown on the following table, except that coated electrodes designated as "moisture resistant" (e.g., E7018R) may be exposed for twice the listed time. The use of portable, heated rod boxes is recommended. Bare wires, flux cored wire and cellulosic electrodes such as E6010 shall be stored in a dry environment. Cellulosic electrodes shall not be stored in rod ovens.

Electrode Type	Hours
E70XX	4
E80XX	2
E90XX or higher strength	1
Stainless and Nickel	4

Commentary: Control of moisture in welding electrodes is not required by Code but is important when welding thick carbon steels and all low alloy steels.

5.7. The internal surfaces of all pipe and piping components ends shall match within 1/8 inch or as specified in the applicable B31 Code section. Where the mismatch is greater than 1/8 inch, the thicker component shall be ground or the thinner component shall be built-up with weld metal so that the internal surfaces align within 1/8 inch.

Commentary: Internal alignment is critical in ensuring adequate weld quality and is not covered by all B31 Code Sections.

5.8. Tools which have been used on materials other than stainless steel or nickel alloys shall not be used on stainless steel or nickel alloys. Final cleaning of all completed stainless steel welds and base metal for two inches on each side of the weld shall be done using 3M Unitized wheels or equivalent, or a commercially available weld cleaning paste that will remove all free iron.

Commentary: Final cleaning using the above methods will ensure that welds do not form ugly rust upon exposure to the atmosphere.

5.9. Except as noted below for GMAW, the root pass of all stainless steel and nickel alloy piping groove welds that are made from the outside shall be made using GTAW or GMAW except as noted below. Such welds shall be purged internally using argon except that nitrogen may be used for purging types 304, 304L, 316, 316L and 317L. The inside of the joint shall be purged such that the root side of the weld exhibits a surface discoloration after welding that is no darker than straw color (see AWS D18.2-1998, discoloration, level 3). Use of removable and water-soluble dams is permitted. If can be demonstrated that removable backing devices provides a finished weld surface that meets the requirements for appearance above without using a backing gas, such devices will be permitted. In addition, where shop welding techniques using GMAW without a backing gas have been demonstrated to provide a root-side surface discoloration limits that meets the above requirements, such techniques are permitted. All root surfaces shall be subject to examination of the root side by the purchaser using remote viewing aids.

5.10. Welds that are made from both sides of the joint do not require purging. The use of backing flux such as “Solar Flux” in lieu of backing gas or welding from both sides is not permitted except with the approval of the Engineer on a case-by-case basis.

Commentary: A reasonably smooth and oxide-free root side is necessary to avoid setting up a corrosion cell between the oxidized surface and the clean stainless surface. A reasonably smooth and oxide-free root side can usually only be achieved by use of a nonreactive backing gas or by welding from both sides. Alternative devices that provide backing and alignment may also protect the root side adequately, but the adequacy of such devices should be demonstrated. Similarly, some shops have developed GMAW techniques in which sufficient shielding gas flows into the open root of a joint to provide a clean root surface; such techniques should be permitted if they can be demonstrated.

5.11. The interpass temperature during welding of stainless steel and nickel alloys shall not exceed 350 degrees F or other lower temperature as required by the Contractor’s WPS.

5.12. Preheat temperature shall be measured using temperature indicating crayons or contact temperature measuring devices. Preheat temperature shall be measured no less than 1 inch away from the edge of the bevel surface.

5.13. Each weld layer shall be visually examined by the welder for cracks, slag, excessive undercut, rollover, etc. before making the next pass. Any defects shall be removed by grinding and, if necessary, rewelding of the defect area.

5.14. The completed weld shall be visually examined by the welding supervisor, including the root side, where accessible. Any unacceptable defects shall be removed, and the defect areas shall be rewelded if necessary for the weld to meet Code and specification requirements. Unacceptable defects shall be those which are given in the applicable code for visual examination.

5.15. Fabricated branch connections, including those made with couplings, weld-o-lets, sock-o-lets and pipe, shall be installed with full penetration joints. Fillet welding or partial penetration welding of such joints is not permitted.

Commentary: Since pressure vessel small nozzles may be welded to vessels using fillet welds, it should be made clear that this practice is not permitted for piping.

5.16. Pipe supports shall be installed as shown on Engineering drawings. In the event of interference, the Contractor shall advise the Owner's Engineer, who shall resolve the interference.

5.17. All pipe to be insulated shall be installed using standoffs (shoes) which will allow clearance as specified in the Class Sheets. Where pipe supports are not shown on the drawing, the following spacings shall be used:

(Engineer to insert table here -- Use of B31.1, Table 121.5 is generally suitable after any concentrated loads, such as valves, pumps, risers, etc. have been independentlysupported.)

5.18. Stainless steel and nickel alloy piping shall be supported directly in carbon steel clamps and other types of supports. The use of a stainless steel shim plate between carbon steel supports and piping is prohibited since such a geometry forms a crevice which can cause pitting attack underneath the shim plate.
5.19. Aluminum, brass, copper and plastic pipe shall be protected from contact with supports with rubber sheet.
5.20. All pipe passing through walls or floors shall pass through a sleeve unless other provision is made on the engineering drawings. Sleeves may be carbon steel or galvanized carbon steel.
5.21. All fabrication waste, such as metal filings, grinding dust, slag, rod stubs, rags, dirt and other debris shall be removed from the interior of each length or pipe, fitting or subassembly before shipping. Each piping subassembly shall be cleaned in accordance with PFI Standard ES-5.
5.22. All flanges shall be raised face flanges unless otherwise noted on the drawings or class sheets. All flanges shall be installed so that the bolt holes straddle the vertical and horizontal centerlines of the pipe. Flat-faced flanges shall be used only when flat-faced flanges are provided on equipment.
5.23. All threaded pipe shall be schedule 80 minimum. Contractor shall not use threaded connections when installing 300 series stainless steel piping over 1/2 NPS.

300 series stainless steel threads will gall (weld together locally at the threads) even with recommended lubricants. Large sizes tend to have this problem more readily than small sizes.

5.24. All open-ended valves shall be provided with a flange, plug or cap, as appropriate.
5.25. Temporary attachments shall be removed by thermal cutting of the weld followed by grinding the remaining weld metal flush to the surface of the pipe. Removal of temporary attachments by hammer blows which fracture the joint into the pipe wall is not permitted.
5.26. Piping subassembly tolerances shall be as shown in Pipe Fabrication Institute (PFI) Standard ES-3.
5.27. Pipe ends and flange faces shall be protected from damage during shipment in accordancw with PFI ES-31. Piping subassemblies shall be loaded for shipment in accordance with PFI ES-37.
5.28. Grooved piping subassembly drawings shall be prepared and dimensioned in accordance with PFI ES-38. Grooved piping assemblies shall meet the fabrication tolerances of PFI ES-39.

6. Quality Assurance

6.1. A formal quality Control program is not a requirement of Contractors who work for the Owner. As a minimum requirement, the Contractor is required to visually examine each pipe weld after the components are aligned and tack welded together, but prior to making the root pass, and the Contractor is required to visually examine each completed weld for conformance to applicable code requirements. This visual examination may be done by the welder's immediate supervisor or higher level personnel, or by a quality control inspector. A record of these visual examinations shall be submitted to the Owner weekly.
6.2. Where visual inspection is required by this specification or by the applicable code, visual examination shall be defined as given in Pipe Fabrication Institute Standard ES-27,
6.3. Nondestructive examination shall be as required by the applicable Code Section. In addition, for piping in which the circumferential stress due to pressure is greater than 40% of the applicable Code Section allowable stress, at least five percent (5%) of the pipe butt welds made by each welder shall be examined by random radiography as provided by PFI ES-48. The number of welds made, the number of radiographs taken and the results of the radiography shall be tracked by the Contractor for each welder.

Commentary: Random radiography is only intended to get the Fabricator/Installer's attention. Where radiographic quality welds are required for service conditions, 100% radiography should be specified. Acceptance criteria are provided by the B31 Code sections.

7. Submittals

7.1. A. The Contractor who will install ASME Section I, Boiler External Piping, shall submit a copy of his Certificate of Authorization to the Owner with the bid proposal. If the Contractor intends to have this work performed by another organization, the name of that organization and a copy of that organization' s Certificate of Authorization shall be submitted to the Owner with the bid proposal. All Boiler External Piping shall be installed in accordance with the requirements of ASME Section I and ASME B31.1.

7.2. The Contractor shall submit with his bid Package those welding procedure specifications and supporting qualification records that he intends to use in the work. In addition, the Contractor shall submit three typical welder qualification records. These documents will be used during the bidding process as an aid to evaluate the Contractor's knowledge about and ability to control welding.

7.3. If the Contractor has a formal quality assurance program which will be implemented on the work, that program may be submitted to the Owner as an aid in evaluating the Contractor's capability. If a quality control program is submitted, it will be considered as part of the Contractor's proposed work, and it shall be implemented on the project.

8.0 Scope of Work and Schedule

8.1 The Contractor shall furnish all piping, fittings, flanges, valves, and other piping components shown on engineering drawings. Contractor shall install the piping components, including attaching lugs, clips, plates, etc. needed to install the piping in accordance with the engineering drawings. The Contractor shall perform all inspection and nondestructive examination required by the applicable code, this specification and engineering drawings.

8.2 The Contractor shall perform work in accordance with the attached schedule. (Engineer to attach proposed installation schedule)

9.0 References

ASME
Two Park Avenue
New York, NY 10016
1-800-THE-ASME
www.asme.org

Pipe Fabrication Institute
655, 32nd Ave., Suite 201
Lachine, QC, H8T 3G6
Tel.: 514/634-3434
Fax: 514/634-9736
www.pfi-institute.org

Typical Piping Class Sheet

(Engineer to develop appropriate class sheets for each service condition using this template)

By specifying any class sheet, the Owner and his Engineer assume full responsibility for selection of the correct material for the service conditions, including temperature and corrosion considerations.

Class: CS-300

Service Temperature: 0 to 650° F.
Service Pressure: 500 psig maximum

Item	Material Specification	Size (NPS)	Remarks
Pipe	ASTM A672 Gr. B70, C1 22	>24	Schedule 40
	ASTM A106 Gr. B	= or < 24	Schedule 40
Fittings	A234, WPS or WBPW	>24	Schedule 40 BW
	ASTM A234, WPB	=< 24	Schedule 40
Flanges	ASTM A105	>2	Class 300, RFWN
		=<2	Class 3000 Socket
welding			
Plate	ASTM A515 or A516, Gr70		
Bolting	ASTM A193r B7	All	Studs and Bolts
	ASTM A194, 2H	All	Heavy Hex Nuts
Gaskets	Asbestos-free, spiral wound		Note 1
Joints:	Welded unless otherwise noted on Engineering Drawing		

Note 1: Flexatallic style CG with Flex-tite super filler, Garlock Style 556, style CR with Permafill. Metal strip shall be type 304 stainless. Alternates shall be approved by the Owner.