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1. Introduction

1.1 Purpose

This Practice provides requirements for fabricating and examining piping systems in accordance with ASME B31.8 Gas Transmission and Distribution Piping Systems, (hereinafter referred to as the Code).

1.2 Scope

This Practice describes the requirements for both shop and field fabricated piping and pipelines constructed in accordance with ASME B31.8. Piping fabrication requirements are provided for materials, welding, forming, and heat treatment.

Examination requirements are provided for piping materials, components, fabrication, assembly, and erection. Requirements for examination documentation are provided. Examination methods, acceptance criteria, and requirements for correction of defective work are also provided.

2. References

Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate. Code section references below are specific to the code editions in effect at the issuance of this Practice.

2.1 Process Industry Practices (PIP)

- PIP PLSC0011 - Installation of ASME B31.8 Metallic Piping
- PIP PLC00005 - Design of ASME B31.8 Metallic Piping
- PIP PLSC0021 - Pressure Testing of ASME B31.8 Metallic Piping
- PIP CTSU1000 - Application of Underground Coatings

2.2 Industry Codes and Standards

- American Petroleum Institute (API)
  - API Std 1104 - Welding of Pipelines and Related Facilities
- American Society of Mechanical Engineers (ASME)
  - ASME Boiler and Pressure Vessel Code (hereafter referred to as the BPV Code) Section IX - “Welding, Brazing and Fusing Qualifications”  
  - ASME B16.25 - Buttwelding Ends
  - ASME B31.8 - Gas Transmission and Distribution Piping Systems
3. Definitions

**owner**: The party who owns the facility wherein the fabricated piping will be used

**purchaser**: The party who awards the contract to the supplier. The purchaser may be the owner or the owner's authorized agent.

**supplier**: The party responsible for providing the fabricated piping

4. Requirements

4.1 General

4.1.1 Piping shall be fabricated in accordance with all the requirements of the Code.

4.1.2 Unless otherwise specified, tolerances for dimensions of fabricated pipe sections shall be in accordance with PFI Standard ES-3.

4.1.3 Pipe support systems shall be in accordance with PIP PLC00005.

4.1.4 The opportunity to witness part or all of the work, including access to facilities required to verify the results shall be provided to the purchaser.

4.2 Materials

4.2.1 All materials shall be in accordance with the piping material specifications indicated on the piping drawings.

4.2.2 Material substitutions, including thicker wall materials, shall be permitted only with the owner's written approval.

4.2.3 Cleanliness

4.2.3.1 Components shall be clean and dry before welding.

4.2.3.2 For fabrication operations that include heating, affected surfaces shall be cleaned of harmful contaminants such as lubricants and paint before performing the operations.
4.2.4 If welding is required to repair a component, approval from the purchaser shall be obtained before proceeding.

4.3 Welding

4.3.1 General

4.3.1.1 Welding requirements including welding procedure preparation, filler metals, approved welding processes, hardness testing, weld overlay, and miscellaneous requirements shall be in accordance with API 1104 or the BPV Code, Section IX.

4.3.1.2 Qualifications of the welding procedures to be used and of the performance of welders and welding operators shall be in accordance with the Code, Section 823 (Qualification of Procedures and Welders) and API 1104.

4.3.1.3 Welds shall be identified in accordance with the Code.

4.3.1.4 Weld maps shall be an acceptable alternative to marking if approved by the owner.

4.3.1.5 Unless tack welds are to be removed during the welding operation, tack welds will be of the same quality and material as the completed weld and shall be fully fused with weld beads.

4.3.1.6 Arc strikes on pipe and fitting surfaces shall be avoided. If arc strikes occur, they shall be removed.

4.3.1.7 Repairs to the pipe and fitting surfaces shall not reduce the wall below the minimum required thickness.

4.3.2 Buttwelds

4.3.2.1 If seam-welded pipes are joined by butt welding, longitudinal weld seams should be positioned at least 25 mm (1 in) or 30 degrees apart.

4.3.2.2 Buttweld joints shall be prepared in accordance with Section 822.1 and Mandatory Appendix I (Fig. I-4) of the Code.

4.3.2.3 For buttwelded joints of unequal thickness and/or unequal specified minimum yield strengths, the weld ends shall be prepared in accordance with Mandatory Appendix I (Fig. I-5) of the Code.

4.3.2.4 Buttweld end valves that have PTFE or other heat-sensitive parts shall be protected from the heat of welding, or Post Weld Heat Treatment (PWHT), in accordance with the valve manufacturer’s instructions.

4.3.2.5 Internal misalignment of piping components to be joined shall not be greater than 1.59 mm (1/16 in).

4.3.2.6 The following methods shall be used as applicable in descending order of preference to minimize misalignment:

a. Rotating the pipe or fitting
b. Correcting out-of-round conditions by using spreaders or line-up clamps
c. Tapering or counter boring with taper to align butt weld ends. Slopes, angles and minimum remaining thickness shall be in accordance with Mandatory Appendix I (Fig I-6) of the Code.

d. Back welding of the root pass

4.3.3 Socket Welds
  4.3.3.1 Minimum dimensions for fillet welds used in the attachment of socket welded joints shall be in accordance with Mandatory Appendix I, (Fig I-6) of the Code.
  4.3.3.2 Weld leg length shall be equal to or greater than the nominal wall thickness of the pipe.
  4.3.3.3 If hardness control for sulfide stress cracking is a concern, welds shall be made with a minimum of two passes.
  4.3.3.4 Pipe insertion into a socket weld fitting should be at least 3.97 mm (5/32 in) or 1 ¼ times the pipe nominal wall thickness, whichever is greater.
  4.3.3.5 The minimum gap between the end of the pipe and the bottom of the socket shall be approximately 1.59 mm (1/16 in) before welding.
  4.3.3.6 Socket weld end valves that have PTFE or other heat-sensitive parts shall be protected from the heat of welding, or PWHT, in accordance with the valve manufacturer’s instructions.

4.3.4 Slip-On Flanges
  4.3.4.1 Minimum dimensions for front and back fillet welds used in the attachment of slip-on flanges shall be in accordance with Mandatory Appendix I, (Fig I-6) of the Code.
  4.3.4.2 The flange face shall be protected from weld spatter.

4.3.5 Seal Welding
  4.3.5.1 Seal welding of threaded joints shall be permitted only if approved by owner.
  4.3.5.2 Both male and female threads shall be free of oil and joint sealant, and the threads shall be fully engaged.
  4.3.5.3 All threads shall be covered by the weld metal.

4.3.6 Backing Rings and Inserts
  4.3.6.1 Permanent backing rings shall not be permitted.
  4.3.6.2 Consumable inserts shall be permitted with the owner’s approval.

4.4 Branch Connections
  4.4.1 Unless otherwise specified, 90-degree branch connections shall be in accordance with the branch connection chart in the applicable piping material specification.
  4.4.2 Welded branch connections shall be in accordance with Section 831.3.3 of the Code.
4.4.3 Reinforced Branch Connections

4.4.3.1 Reinforcing pads shall be of the same nominal composition and properties as the header (run) pipe.

4.4.3.2 Each reinforcing pad, or separately welded portion of the pad, shall have a ¼-in NPT vent hole drilled and tapped before installation of the pad.

4.4.3.3 All required pipe examinations and repairs shall be completed and approved before reinforcing pads are welded onto the pipe.

4.4.3.4 Reinforcement of welded branch connections shall be in accordance with the Code, Section 831.4 and Mandatory Appendix F.

4.5 Machined Surfaces

4.5.1 Machined surfaces (e.g., flange faces) shall be protected from damage and deterioration during all operations.

4.5.2 Damaged machined surfaces shall be repaired, or the component shall be replaced.

4.6 Forming and Bending

4.6.1 Cold bends shall be in accordance with the Code, Section 841.2.3

4.6.2 All hot bends shall be in accordance with ASME B16.49.

4.7 Flanges

4.7.1 Flanges shall be installed in accordance with ASME B16.5.

4.7.2 Unless otherwise specified, bolt holes of fixed flanges shall be oriented as follows:
   a. Vertical flange faces: A pair of bolt holes shall straddle the vertical centerline
   b. Horizontal flange faces: A pair of bolt holes shall straddle the plant north-south centerline
   c. Sloping flange faces: A pair of bolt holes shall straddle the plane defined by the centerline of the pipe and a vertical line

4.7.3 Lapped flanges shall be prevented from sliding back more than 13 mm (1/2 inch) by two or more evenly spaced weld buttons or other means that do not hinder rotation.

4.8 Orifice Runs

4.8.1 Welding neck orifice flanges shall have the same bore as the pipe.

4.8.2 Orifice runs shall not contain welds except at the flanges.

4.8.3 Welds at orifice flanges shall be ground or machined smooth and flush on the inside of the pipe.

4.9 Cleaning

4.9.1 Fabricated assemblies shall be cleaned and completely drained of all liquid after fabrication and examination in accordance with PFI Standard ES-5, Cleaning of Fabricated Piping.
4.9.2 Water used to clean piping shall be completely removed and the piping dried.

4.9.3 Water used to clean stainless steel piping shall contain 50 ppm chlorides maximum.

4.9.4 Flange faces shall be cleaned of any applied paint or coating using a method that shall not damage the machined surface.

4.10 Examination and Testing

4.10.1 General

4.10.1.1 Examinations shall be performed after required heat treatment and before pressure testing.

4.10.1.2 External and accessible internal surfaces of joints and components to be examined shall be free of rust, scale, weld flux or spatter, and paint. The surfaces shall be ground if necessary, to eliminate irregularities that can obscure or confuse the interpretation of imperfections.

4.10.1.3 Examinations shall be performed in accordance with Section 826 of the Code.

4.10.1.4 All examination personnel shall be qualified in accordance with the Code and approved by the Owner in accordance with API 1104.

4.10.1.5 Acceptance criteria for welds are stated in API 1104 in accordance with Section 826 of the Code.

4.10.1.6 Any items rejected because of defects shall be repaired or replaced and re-examined in accordance with this Practice and the Code.

4.10.2 Examination Methods

4.10.2.1 General

1. Visual examination, including any in-process examination, shall be performed and repairs made before any other examinations are performed.

2. Methods of examination shall be in accordance with the Code.

3. The owner shall retain the right to designate the piping that shall be randomly tested.

4. The number of welds that must be visually examined and radiographically examined is contingent upon the intended design pressure and resulting percent specified minimum yield strength (SMYS) and the class location of the pipeline in accordance with the Code, Section 826.

4.10.2.2 Visual Examination (VT)

1. The method of visual examination shall be in accordance with the BPV Code, Section V, Article 9.

2. Examiners shall be qualified in accordance with ASNT SNT-TC-1A.
4.10.2.3 Radiographic Examination (RT)

1. The method of radiographic examination shall be in accordance with API 1104.

2. If the owner approves, ultrasonic or magnetic particle examination may be substituted for radiography.

4.10.2.4 Liquid Penetrant Examination (PT)

1. Materials
   a. Only visible post-emulsifiable penetrants (see ASTM E165, Procedure B-2, “Practice of Liquid Penetrant Inspection Method”) shall be used.
   b. Penetrant products shall be subject to the purchaser’s approval.
   c. If more than one penetrant manufacturer’s products or product lines are approved, intermixing of the products shall not be permitted.

2. The method of liquid penetrant examination shall be in accordance with the BPV Code, Section V, Article 6, “Liquid Penetrant Examination.” BPV Code, Section V, Article 24, “Liquid Penetrant Standards” shall also apply.

4.10.2.5 Ultrasonic Examination (UT)

The method of ultrasonic examination shall be in accordance with the BPV Code, Section V, Article 5, “Ultrasonic Examination for Materials and Fabrication.”

4.10.2.6 Magnetic Particle Examination (MT)

The wet method of magnetic particle examination shall be in accordance with the BPV Code, Section V, Article 7, “Magnetic Particle Examination,” unless otherwise specified by owner.

4.10.3 Leak Testing

Leak testing shall be performed in accordance with PIP PLSC0021.

4.11 Heat Treatment

4.11.1 General

4.11.1.1 The supplier shall be responsible for determining if heat treatment is required by the Code.

4.11.1.2 Minimum requirements for heat treating before and after welding shall be in accordance with the Code, Sections 824 and 825.

4.11.2 Preheating

4.11.2.1 Minimum requirements for preheating shall be in accordance with the Code, Section 824.
4.11.2.2 Carbon steels having a carbon content in excess of 0.32% or a carbon equivalent in excess of 0.65% shall be preheated according to the qualified welding procedure.

4.11.2.3 Temperature monitoring during the preheating process shall be accomplished with temperature-indicating crayons or thermocouple pyrometers.

**4.11.3 Stress Relieving Heat Treatment**

4.11.3.1 Minimum requirements for PWHT shall be in accordance with the Code, Section 825.

4.11.3.2 Carbon steels having a carbon content in excess of 0.32% or a carbon equivalent in excess of 0.65% shall be stress relieved as prescribed in the BPV Code, Section VIII.

4.11.3.3 Stress relieving shall be performed at temperatures specified in Paragraph 825.6 of the Code.

4.11.3.4 Heat treatment should be applied gradually and held at the appropriate temperature for 1 hour per inch of pipe wall thickness with a minimum of ½ hour.

4.11.3.5 Details on methods of stress relieving are contained in the Code, Section 825.7.

4.11.3.6 Temperature monitoring during the stress relieving process shall be accomplished with temperature-indicating crayons or thermocouple pyrometers.

**4.12 Painting**

4.12.1 If atmospheric conditions are conducive to external corrosion, piping shall be surveyed frequently enough to ensure the paint is maintained in good condition.

4.12.2 Painting shall be in accordance with the specifications furnished by purchaser.

*Comment:* See PIP CTSU1000 for selection of applicable coating system.

**4.13 Marking**

4.13.1 Markings shall be in accordance with the Section 813 and B813 of the Code.

4.13.2 Valves meeting NACE MR0175/ISO 15156 shall be identified with a permanent tag or marking.

**4.14 Shipping or Storage**

4.14.1 Flange faces shall be protected from damage during shipment and storage by wood or plastic covers bolted, snapped, or wired on.

4.14.2 Carbon steel flange faces shall be kept rust-free.

4.14.3 Pipe ends shall be covered by durable self-fastening plastic covers.

4.14.4 Threaded nipples, couplings, and bosses shall be protected with metal or plastic thread protectors.
4.15 Documentation

4.15.1 Unless otherwise specified, documentation required by the Code, and any other documentation required by the owner shall be retained by the supplier until job completion and then transmitted to owner.

4.15.2 Documentation retention times shall be in accordance with owner requirements.

4.15.3 The documentation shall be made available to the purchaser upon request.

4.15.4 A copy of each Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), and the qualification record of each welder and welding operator shall be available and shall be provided to the purchaser if requested.

4.15.5 Documentation shall be provided to the Purchaser stating the types of examination applied to each piping system and/or pipe spool and recording defects and corrective measures applied.

4.15.6 Documentation shall be provided to the purchaser certifying the specified heat treatment of all piping covered by this Practice, including the following information:

   a. All temperature charts, properly identified and dated, with a list of spools and components to which each chart applies
   b. A description of the equipment used and calibration dates of thermocouples and the recorder
   c. Hardness test results

4.15.7 Material test reports shall be provided for all pressure containing components and welding supplies.