

## SCOPE

- I 1.1 This practice covers the fabrication, inspection and testing of piping.
- I 1.2 **An asterisk (\*)** indicates that a decision by the purchaser is required or that additional information is specified by the purchaser.

## SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practices, codes, and standard which shall be used with this practice.
- I \* 2.2 **Table 2** lists the practices, codes, standards, and specifications, which shall be used with this practice as specified by the Purchaser.

TABLE 1

| PRACTICES            |                                       |
|----------------------|---------------------------------------|
| IP 18-7-1            | Welding Procedures                    |
| IP 18-10-1           | Additional Requirements for Materials |
| IP 20-1-1            | Inspection of Equipment and Materials |
| IP 20-1-3            | Quality Programs                      |
| CODES AND STANDARD   |                                       |
| <b>ASME Codes</b>    |                                       |
| Section V            | Nondestructive Examinations           |
| Section VIII         | Pressure Vessels, Division 1          |
| B31.3                | Process Piping                        |
| <b>ASME Standard</b> |                                       |
| B16.25               | Buttwelding Ends                      |

TABLE 2

| PRACTICES                                        |                                                                                             |
|--------------------------------------------------|---------------------------------------------------------------------------------------------|
| IP 18-12-1                                       | Positive Material Identification                                                            |
| IP 19-3-2                                        | Refractory Linings for Pressure Vessels and Piping                                          |
| IP 19-7-1                                        | Protection of Stainless Steel During Fabrication, Shipping, Storage, and Field Construction |
| CODES, STANDARDS, AND SPECIFICATIONS             |                                                                                             |
| <b>ASME Codes</b>                                |                                                                                             |
| Section I                                        | Power Boilers                                                                               |
| B31.1                                            | Power Piping Code                                                                           |
| <b>ASME Standard</b>                             |                                                                                             |
| B1.20.1                                          | Pipe Threads, General Purpose (Inch)                                                        |
| <b>ANSI / AWS Code and Specifications</b>        |                                                                                             |
| D1.1                                             | Structural Welding Code - Steel                                                             |
| A5.XX Series                                     | Filler Metal Specifications ASTM Standard                                                   |
| E 142                                            | Controlling Quality of Radiographic Testing                                                 |
| <b>PFI (Pipe Fabrication Institute) Standard</b> |                                                                                             |
| ES-24                                            | Pipe Bending Methods, Tolerances, Process and Material Requirements                         |

- I \* 2.3 **Fabrication of all piping** shall be performed in accordance with **ASME B31.3, ASME B31.1, or ASME Section I** as applicable, and the additional requirements of this practice.
- I 2.4 **When compliance with any code or standard by a local jurisdiction** is mandatory, the requirements prescribed therein **shall also be met**.

## DEFINITIONS

- I 3.1 **Small piping connections.** Any branch connection NPS 2 (50 mm) or less.

|                  |           |                                         |                                                                                   |
|------------------|-----------|-----------------------------------------|-----------------------------------------------------------------------------------|
| <b>IP 3-18-1</b> |           | <b>Piping Fabrication Shop or Field</b> |  |
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| Rev. 3           | June 1999 |                                         |                                                                                   |

(This practice is appropriate for attachment to Inquiry or Purchase Document)

- I 3.2 **Dangerous materials**, as used herein, includes the following materials:
  - a. **Toxic** materials, such as phenol, hydrogen sulfide, chlorine.
  - b. **Highly corrosive** materials, such as acids, caustic and other similar materials.
  - c. **Flammable materials** (including light hydrocarbons lighter than 68 degrees API).
  - d. **Combustible liquids**.
  - e. **Boiler feedwater and steam**, in systems requiring ASME Class 300 and higher ratings.
  - f. **Oxygen** in concentrations greater than 35%.
- I 3.3 **Non-dangerous materials**, as used herein, include all materials not listed as dangerous in **Par. 3.2**.
- I 3.4 **Combustible liquids**. High flash liquids [flash points 100°F (38°C) or higher] when handled at temperatures more than 15°F (8°C) below their flash point.
- I 3.5 **Flammable liquids**. Low flash liquids [flash point below 100°F (38°C)]; and high flash liquids [flash point 100°F (38°C) or higher] when handled at temperatures above or within 15°F (8°C) of their flash points.
- I 3.6 **Flammable materials** (including light hydrocarbons lighter than 68 degrees API). Flammable liquids; hydrocarbon vapors; and other vapors, such as hydrogen and carbon disulfide, that are readily ignitable when released to atmosphere.
- I 3.7 **Wet H<sub>2</sub>S** is defined as greater than 50 ppm of H<sub>2</sub>S in the water phase.
- I 3.8 **The term Inspector**, as used herein, refers to the Owner's Representative.

#### SMALL PIPING DOCUMENTATION

- I 4.1 The following **information** for **small piping connections** shall be **shown** on the **Engineering Drawings**:
  - a. Specific location and orientation of small piping connections.
  - b. Connection size and schedule.
  - c. Valve or fitting type.
  - d. Designation of connections to be gusseted and specifications to be used for gussets.
  - e. Special welding requirements.
  - f. Temporary valves and nipples that are used only during pressure testing shall be indicated on the drawings.

#### ATTACHMENT MATERIALS

- R \* 5.1 Unless otherwise specified, **lugs, brackets, insulation supports, or other attachments** that must be **welded to piping**, shall be of the **same nominal chemical composition and physical properties as the piping component** to which they are attached.

#### BENDS, MITER BENDS, AND ELBOWS

- R \* 6.1 **Pipe bends** shall comply with the **following requirements**:
  - a. **Fabrication** shall be in accordance with ES-24 of the **Pipe Fabrication Institute**.
  - \* b. The **centerline radius of pipe bends** shall be equal to at least three times the nominal pipe diameter. Proposals to use **smaller radius pipe bends** shall be submitted to the purchaser for **approval by the Owner's Engineer**.
- R 6.2 **Miter bends** may be used where the pipe diameter exceeds NPS 12 (300 mm) and shall comply with the following:
  - a. Bends exceeding 45 degrees shall be at least 3-piece (2 miter cuts), with not less than 4 times the pipe wall thickness between the centerlines of the welds at the crotch, or 1 in. (25 mm), whichever is greater.
  - b. Bends shall have a centerline radius at least equal to the nominal pipe size.
  - c. The maximum miter angle (half the change of directions) shall be 22-1/2 degrees up to 200 psig (1380 kPa) design pressure, 15 degrees up to 400 psig (2760 kPa), and 11-1/4 degrees over 400 psig (2760 kPa).
- R \* 6.3 **Butt welding elbows** shall be of the **long radius type** unless otherwise approved by the Owner's Engineer.

### DIMENSIONAL TOLERANCES

- R 7.1 Tolerances for finished fabricated piping shall conform to [Figure 1](#).

### LOCATION OF CONNECTIONS

- O \* 8.1 All take-off connections for steam, instrument air, fuel gas and other gases containing moisture shall be from the top of the supply header.
- O \* 8.2 Condensate line connections into condensate return headers shall be at the top of the header.

### BRANCH CONNECTIONS LARGER THAN NPS 2 (50 mm)

- R \* 9.1 Integrally reinforced branch welding fittings which abut the outside surface of the run wall, in sizes NPS 4 (100 mm) and larger, are not permitted under any of the following conditions, unless approved by the Owner's Engineer:
- a. The d/D ratio (branch diameter/run diameter) exceeds 0.8.
  - b. The run piping wall thickness is less than standard schedule.
  - c. The run piping wall thickness is less than 0.75 in. (19 mm) where outside diameter exceeds 36 in. (900 mm).
- R 9.2 Pad reinforced branch connections are not permitted whenever the piping design temperature is 800°F (427°C) or greater.
- R 9.3 If pad-type reinforcement is used for full size branch connections, it shall be of the complete-encirclement type.
- R 9.4 Fabricated branch connections. Reinforcing pads (when required) shall be added as a subsequent fabrication step after visual inspection of the branch-to-header weld, and shall be provided with a minimum 1/8 in. (3 mm) drilled vent hole in each separate pad section.

### SMALL PIPING CONNECTIONS

- R 10.1 The minimum schedule of nipples that are used for branch connections NPS 2 (50 mm) or smaller shall be as follows: (does not apply for connections to rotating equipment)

| MATERIAL                             | ≤ NPS 1-1/2 (40 mm) | NPS 2 (50 mm) |
|--------------------------------------|---------------------|---------------|
| Carbon and low alloy steel           | 160                 | 80            |
| Stainless and other high alloy steel | 80S                 | 40S           |

- R 10.2 Nipples that are threaded over their entire length shall not be used.
- S 10.3 Vibrating service or dangerous materials service. A block valve shall be provided for the purpose of isolating all piping connections NPS ≤ 1-1/2 (40 mm) to main headers of any size. (Excludes control valve stations.)
- R \* 10.4 When a valve is provided for the purpose of isolating piping connections ≤ NPS 1-1/2 (40 mm), the outlet of the valve shall be located within 9 in. (225 mm) of the branch connection, measured along the branch pipe axis. In cases where adhering to the 9 in. (225 mm) dimension (pipe wall to valve outlet) is not practicable, such deviations shall be approved by the Owner's Engineer.

### BRACING

- S,R 10.5 Piping connections NPS ≤ 1-1/2 (40 mm) shall be braced for the following applications:
- \* a. For both vibrating and non-vibrating services, bracing is required for piping connections ≤ NPS 1-1/2 (40 mm) that are fabricated using a nipple welded directly to the run pipe, except for Category D fluid services.
  - b. Bracing is not required for small piping connections in any service that connect to pipe of the same size or one size larger.

### SMALL PIPING CONNECTIONS (Cont)

- c. **Categories of equipment in vibrating service requiring bracing** of piping connections, and the extent of bracing, shall be per the following:

| PRIMARY EQUIPMENT OR SERVICE CATEGORY                                                             | The first nipple and valve shall be braced for: (1) (2)                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reciprocating Compressors                                                                         | Connections to interstage, upstream, and downstream piping and equipment associated with reciprocating compressors (Includes first major piece of equipment upstream and downstream of compressor).                                                                                                  |
| Centrifugal Compressors and Steam Turbines                                                        | Connections to piping within the greater of 20 ft (6 m) or 20 pipe diameters, measured along the pipe axis, from the equipment nozzle.<br><br>Design of all connections to piping equal to or greater than NPS 36 (900 mm) shall be submitted to the purchaser for approval by the Owner's Engineer. |
| Reciprocating Pumps                                                                               | Connections to suction and discharge piping and equipment for reciprocating pumps. (Includes first major equipment upstream and downstream of pump.)                                                                                                                                                 |
| Centrifugal Pumps and Rotary Pumps                                                                | Connections to pump piping within the greater of 20 ft (6 m) or 20 pipe diameters, measured along the pipe axis, from the equipment nozzle.                                                                                                                                                          |
| Centrifuges                                                                                       | Connections to centrifuge piping within the greater of 20 ft (6 m) or 20 pipe diameters, measured along the pipe axis, from the equipment nozzle.                                                                                                                                                    |
| Machinery where rotating or reciprocating component speed range is 60 to 1000 rpm (1 to 17 rev/s) | Connections to all piping connected to or supported from any type of rotating equipment or its supporting structure. (Includes first major piece of equipment upstream and downstream of machine.)                                                                                                   |
| Piping or Equipment subject to Process Induced Vibration                                          | Connections to piping or equipment subject to process induced vibration (e.g., fluid solids units, lines in two phase flow, hydraulic shock from rapid valve operation, high pressure letdown systems.)                                                                                              |
| Pressure Relieving (PR) Devices                                                                   | Connections to PR device inlet and discharge piping within 20 ft (6 m) or 20 pipe diameters, measured along the pipe axis, from the PR device.                                                                                                                                                       |

**Notes:**

- (1) Bracing of connections on the primary equipment shall be done by the equipment supplier.
- (2) Unless specified, bracing of Class 800 integrally reinforced extended body valves or integrally reinforced extended fittings with Class 800 valves is not required for pressure gage connections, connections which terminate at the valve or continue as tubing, if the valve centerline is located within 9 in. (225 mm) of the connection.

S,R 10.6 Bracing design shall be as follows:

- a. **Material** for welded gussets shall be of the same nominal chemical composition as the connected parts except that carbon steel may be used for gusseting **P-1, P-3, P-4, and P-5** materials.