PIP PNC00001
Pipe Support Criteria for ASME B31.3
Metallic Piping
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

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1. **Scope**

This Practice provides design criteria for designing and selecting pipe supports for aboveground metallic piping systems in accordance with ASME B31.3 (henceforth referred to as the Code). This Practice is limited to temperature ranges of 427˚C (800˚F) and less, and shall not be used for cryogenic service (i.e., temperature less than -101˚C (150˚F)).

2. **References**

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The latest edition and addenda of the following references in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

- PIP PNC00004 – Piping Flexibility Analysis for ASME B31.3 Metallic Piping
- PIP PNFS0001 – Pipe Support Details
- PIP STS05120 – Fabrication of Structural and Miscellaneous Steel Specification

2.2 **Industry Codes and Standards**

- American Society of Mechanical Engineers (ASME)
  - ASME B31.3 – Process Piping (Code)
- American Society for Testing and Materials (ASTM)
  - ASTM A123 – Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products
  - ASTM A325 – High Strength Bolts for Structural Steel
- American Welding Society (AWS)
  - AWS D1.1 – Structural Welding Code – Steel
  - AWS D1.6 – Structural Welding Code – Stainless Steel
- Manufacturers Standardization Society (MSS)
  - MSS SP-58 – Pipe Hangers and Supports – Material, Design and Manufacturer

3. **Definitions**

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

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

**supplier**: The party responsible for performing engineering and detail design of the piping support systems
4. Requirements

4.1 General

4.1.1 Supports for piping systems shall be in accordance with the Code, PIP PNC00004, and this Practice.

4.1.2 The pipe supports, guides, anchors, and attachments details shall be provided in accordance with PIP PNFS0001.

4.1.3 Unless otherwise specified by the purchaser, the details shall be submitted to the owner for approval.

4.1.4 Expansion and contraction forces and movements in piping shall be considered in the design of the pipe supports.

4.1.5 The effect of frictional resistance to thermal movement of the pipe shall be considered in the design of piping systems and in the design of supports.

4.1.6 Pipe support design shall be in accordance with MSS SP-58.

4.1.7 Structural steel for support design shall be in accordance with PIP STS05120.

4.1.8 Welded joints for pipe supports shall be in accordance with AWS D1.1 or AWS D1.6.

4.2 Design Requirements

4.2.1 Welded Attachments to Piping (Excluding Trunnions)

4.2.1.1 Pipe attachment welds shall be in accordance with the Code.

4.2.1.2 For carbon steel and ferrous pipe materials through 9% chrome operating between -29°C (-20°F) and 260°C (500°F), pipe support attachment material shall be carbon steel.

4.2.1.3 For carbon steel and ferrous pipe material through 9% chrome operating above 261°C (501°F), pipe support attachment material shall be the same as the supported pipe.

4.2.1.4 For pipe material other than specified in Sections 4.2.1.2 and 4.2.1.3, pipe support attachment material shall be the same as the supported pipe.

4.2.1.5 If wear pads are required, wear pad minimum dimensions shall be 406-mm (16-inches) long by 1/4 pipe circumference. The thickness shall be 6 mm (1/4 inch) for sizes up to and including NPS 24, and 10 mm (3/8 inch) for larger sizes.

4.2.1.6 Pipe supports on uninsulated cyclic service piping require the use of a wear pad with a 3-mm (1/8-inch) weep hole. The thickness of the pad shall not exceed the pipe wall thickness.

4.2.2 Clamped Attachments to Piping

4.2.2.1 Clamp material shall be in accordance with Table 1:
Table 1 – Clamp Material Selection

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Pipe Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Steel/Chrome-Moly</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>-29°C to 260°C (-20°F to 500°F)</td>
<td>Galvanized CS</td>
</tr>
<tr>
<td>261°C to 399°C (501°F to 750°F)</td>
<td>Galvanized or Coated CS</td>
</tr>
<tr>
<td>&gt; 399°C (&gt;750°F)</td>
<td>Compatible Material Suitable for Temp.</td>
</tr>
</tbody>
</table>

4.2.2.2 Galvanized clamps may be used with stainless steel piping operating between 501°F (260°C) and 750°F (399°C) if a thin-gauge (28-gauge minimum) stainless steel isolation shield is inserted between the clamp and the pipe.

4.2.3 Pipe Support Trunnions

4.2.3.1 Unless otherwise specified by the purchaser, materials for trunnions, reinforcing pads, and gussets shall be the same nominal composition as the supported pipe.

4.2.3.2 Unless otherwise specified, reinforcing pads shall not be permitted at elbows.

4.2.3.3 Adjustable base trunnions may be used to accommodate differences in elevation or field tolerances.

4.2.4 Supports for Insulated Piping

4.2.4.1 Supports for insulated piping shall be such that insulation shall not be damaged at the point of support because of pipe movement.

4.2.4.2 Supports for cold-insulated pipe shall be supported to avoid cold bridges and protrusions through the vapor barrier.

4.2.4.3 Supports for piping insulated for cold conservation or anti-sweat shall be designed to prevent the formation of condensation or ice.

4.2.4.4 Supports for piping insulated for cold conservation or anti-sweat shall be designed so that the insulation cannot be crushed.

4.2.4.5 Supports for insulated piping shall be designed for both thermal and acoustic insulation thickness.

4.2.4.6 Trunnions on cold-insulated piping shall be insulated for a length equal to T+3t, where T is the insulation thickness of the line and t is the insulation thickness of the trunnion. Thereafter, the trunnion shall have a minimum uninsulated length of 150 mm (6 inches).

4.2.4.7 If the trunnion length is not in accordance with Section 4.2.4.6, either the entire trunnion shall be covered with cold insulation or a cold-insulated support shall be used.
4.2.5 **Support for Load-Sensitive Equipment Nozzle**

For piping connected to load-sensitive equipment, the support system shall be designed to minimize the weight and weight moment on the equipment nozzle.

4.2.6 **Pipe Support Brackets for Vertical Vessels**

4.2.6.1 The pipe support bracket for a vessel nozzle shall be located as close to the nozzle as practically possible.

4.2.6.2 Support for vessel overhead lines may require design for hydrostatic test conditions.

4.2.6.3 The spacing of vessel piping guides shall be in accordance with the maximum allowable piping span specified in *PIP PNC00004*.

4.2.6.4 If pipe is installed while the vessel is in the horizontal position, the vessel attachments, piping supports, and guide brackets shall be designed for this temporary horizontal position.

4.2.7 **Supports for Valve Operator**

Valves and valve operators shall be evaluated and supports shall be provided as required.

4.2.8 **Supports for Relief Valve Piping**

Reaction forces of safety relief devices shall be evaluated and supports shall be provided as required.

4.2.9 **Supports for Slug Flow**

Reaction forces acting at changes in direction due to slug flow shall be evaluated and supports shall be provided as required.

4.2.10 **Supports for Reciprocating Compressor and Pump Piping**

4.2.10.1 Regardless of the performance of an acoustic study, all lines subject to vibration because of pulsation of reciprocating compressors or pumps shall be restrained in directions perpendicular to the longitudinal axis of the pipe.

4.2.10.2 Either clamp-type supports allowing only axial movement or holddown-type supports allowing both axial and lateral movements shall be used.

4.2.10.3 Coupling moments created by the clamps shall be evaluated and accommodated by the support system.

4.2.10.4 Pipe supports should preferably be supported on concrete.

4.2.10.5 The maximum unsupported spans of lines subject to the effects of vibration shall be evaluated and supports shall be provided as required.

4.2.10.6 All supports shall be designed for the various dynamic loads imposed by the vibrating lines.

4.2.10.7 Adjustable wedge-type supports for volume bottles located directly under the compressor cylinders shall be used. These supports shall be
designed to allow final support adjustment when a full operating
temperature has been reached.

4.2.10.8 Cinch anchors shall not be used for supports that anchor or restrain
vibrating lines.

4.2.10.9 Vibrating lines shall have independent support structures if feasible.

4.2.11 Supports for Piping with Acoustically-Induced Vibration

4.2.11.1 For a piping system that has acoustically-induced vibration, the piping
system and the supports shall be designed for the effects of vibration
and fatigue.

4.2.11.2 The use of bolted-on supports, supports with full circumferential bands,
or stiffening rings should be considered.

4.2.12 Supports for Large OD Pipe (Greater than NPS 24)

4.2.12.1 The maximum allowable span for various pipe diameters and wall
thicknesses shall be determined.

4.2.12.2 For pipe greater than NPS 24, saddle reinforcement or wear pads shall
be provided at the point of support bearing to handle the weight load
and to protect from abrasion.

4.2.12.3 Wear pads shall be fabricated from equal or higher grade material than
the supported pipe.

4.2.12.4 The wear pad bearing surface shall be a minimum of 100 mm (4 inches)
in length.

4.2.12.5 If possible, pipe shoes may be provided in place of wear pads.

4.2.13 Corrosion Protection

4.2.13.1 Unless otherwise specified, stainless steel and copper pipe support
components shall not be provided with any surface coating.

4.2.13.2 Unless otherwise specified, spring coils shall be coated in accordance
with the manufacturer’s standard.

4.2.13.3 Unless otherwise specified, all support steel connecting to a structure
shall be galvanized.

4.2.13.4 All pipe supports (e.g., lugs, shoes, trunnions, etc.) welded to pipe
spools shall be prepared and coated the same as the supported pipe.

4.2.13.5 Unless otherwise specified, all of the following support elements shall
be hot-dip galvanized:
   a. Eye nuts
   b. Turn buckles
   c. Beam attachments
   d. Adjustable base supports
   e. Spring housings
f. Load flanges
g. Threaded rods
h. Bolts and nuts

4.2.13.6 Galvanized coating shall be in accordance with ASTM A123 with the following exceptions:

a. The weight of zinc coating shall not average less than 0.7 kg/m² (2.25 oz/ft²).
b. An individual specimen shall not show less than 0.6 kg/m² (2.0 oz/ft²) of zinc coating.

4.2.14 Hydrostatic Test Condition

If temporary supports for hydrostatic testing are not provided, permanent supports shall be designed for a hydrostatic test case.

4.3 Pipe Support Types Selection

4.3.1 Shoes

4.3.1.1 Shoes shall be provided for insulated piping to prevent damage to the pipe insulation and to provide a sliding surface for pipe movement.

4.3.1.2 Clamp-on-type shoes shall be provided if welding to the pipe is not permitted or is impractical (internally lined piping, galvanized piping, piping requiring post-weld heat treatment, etc.).

4.3.2 Guides, Stops, and Anchors

4.3.2.1 Pipe support guides, stops, and anchors shall be provided for the following applications:

a. Control movement of the piping to meet stress and flexibility requirements
b. Provide restraint against static, transient, and dynamic forces
c. Prevent excessive pipe movement
d. Provide stability to the piping geometry

4.3.2.2 The anchor and guide system on piping with unrestrained expansion joints shall be designed in accordance with the Code.

4.3.2.3 If more than one piping system is anchored or guided on a common structure, the structure shall be designed for the most severe combination of the loads.

4.3.3 Rod Hangers

4.3.3.1 Rod hangers may be provided if support underneath the pipe is impractical.

4.3.3.2 In general, rod hangers should be minimized.

4.3.3.3 The design shall ensure that rod hangers are not subject to movements exceeding 4 degrees of swing.
4.3.4 Brackets and Structural Supports

4.3.4.1 If attaching brackets to fireproofed steel, the fireproofing shall be removed and replaced. Brackets shall not be attached to the fireproofing.

4.3.4.2 Support brackets shall not be attached to ladders, handrails, and other nonload-carrying structures.

4.3.5 Base Supports

4.3.5.1 Base supports shall be provided if piping is positioned close to grade level or platforms. Typical types of base supports are trunnions and stanchions.

4.3.5.2 Criteria shall be developed for installing base supports directly onto paving.

4.3.5.3 If the paving load is exceeded, an independent foundation shall be provided.

4.3.5.4 Base supports may be supported directly by platform grating if criteria has been developed and the supports meet that criteria.

4.3.6 Spring Supports

4.3.6.1 Spring supports shall be provided to support piping while allowing vertical thermal movements.

4.3.6.2 Spring supports shall be individually sized and selected.

4.3.6.3 All spring design data shall be submitted to the purchaser.

4.3.6.4 Variable spring supports may be provided if the variation between the installed load and the operating load is 25% or less.

4.3.6.5 Constant spring supports shall be considered if the variation between the installed load and the operating load is greater than 25%.

4.3.6.6 Constant spring supports may be provided for the following applications:

   a. For piping with large vertical movements
   b. The limits of the variable spring supports are exceeded or become impractical
   c. To reduce equipment nozzle loads

4.3.6.7 Selection of spring hangers shall also be in accordance with Section 4.3.3 of this Practice.

4.3.7 Sway Braces

4.3.7.1 Sway braces may be provided for the following applications:

   a. Control vibration
   b. Absorb shock-loading
   c. Restrain thermal movement
   d. Brace a piping system against sway

4.3.7.2 Sway braces shall not be permitted for lines connected to reciprocating compressors or pumps.
4.3.8 Sway Struts
Sway struts may be provided to control directional movement of piping from thermal expansion or contraction.

4.3.9 Hydraulic or Mechanical Snubbers
Hydraulic or mechanical snubbers shall be provided to protect a piping system from impulse or shock-loading from earthquake, flow transients, or wind gusts; and if gradual thermal movement is required.

4.3.10 Slide Plates
4.3.10.1 Slide plates shall be provided to reduce frictional forces resulting from pipe movements.
4.3.10.2 The top surface shall be larger than the bottom surface to prevent the accumulation of debris and ice on the sliding surfaces.