PIP PNE00004
Steam Trap Guidelines
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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# PIP PNE00004
Steam Trap Guidelines

## Table of Contents

1. **Introduction** ........................................... 2  
   1.1 Purpose ............................................. 2  
   1.2 Scope ............................................... 2  

2. **References** ........................................... 2  
   2.1 Process Industry Practices ......................... 2  
   2.2 Industry Codes and Standards ....................... 2  

3. **Definitions** ........................................... 2  

4. **Design, Layout, and Piping** ........... 3  
   4.1 General ............................................. 3  
   4.2 Design ............................................... 3  
   4.3 Layout ............................................... 4  
   4.4 Piping ................................................ 5  

5. **Selection** ............................................. 7  

6. **Installation** ........................................... 8  

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**Process Industry Practices**

**Page 1 of 9**
1. **Introduction**

1.1 **Purpose**
This Practice provides guidelines for steam traps.

1.2 **Scope**
This Practice provides guidelines for selection, design, layout and installation of steam traps.

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 will be used herein where appropriate.

2.1 **Process Industry Practices (PIP)**
- PIP CTSE1000 – *Application of External Coatings*
- PIP PNSC0035 – *Steam Tracing Specification*
- PIP PN01CS1S02 – *Piping Material Specification 01CS1S02, Class 150, Carbon Steel, Socket Weld, 0.063” C.A., Steam/Condensate*
- PIP PN03CS1S02 – *Piping Material Specification 031CS1S02, Class 300, Carbon Steel, Socket Weld, 0.063” C.A., Steam/Condensate*
- PIP PN06CS1S01 – *Piping Material Specification 06CS1S01, Class 600, Carbon Steel, Socket Weld, 0.063” C.A., Steam/Condensate*

2.2 **Industry Codes and Standards**
- American Society of Mechanical Engineers (ASME)
  - ASME B31.3 – *Process Piping (Code)*
  - ASME Boiler and Pressure Vessel Code, Section IX – *Welding and Brazing Qualifications*

3. **Definitions**

*backpressure:* Gauge pressure measured at the steam trap or condensate removal device outlet. Typically, backpressure is the sum of:
- Pressure in the condensate receiver or header
- Static head from lift after the trap (2.3 ft of head = 1 psig)
- Friction losses

*inlet pressure:* Gauge pressure measured at the steam trap or condensate removal device inlet

*non-pumped condensate header:* Piping system that conveys condensate directly from a steam trap or multiple steam traps to a collection vessel. This type of header typically transports condensate under two-phase conditions (condensate and flash steam).
pressure powered pump: Positive displacement device for discharging liquids by using steam, air, or other inert gases as a motive force if the differential pressure is too low, or negative, causing a line or vessel to retain condensate

pumped condensate header: Piping system that conveys condensate to a collection vessel by using a pump to drive the condensate into a line that is fully flooded with condensate (single phase flow)

stall: Condition that exists if there is insufficient differential pressure to drive condensate through the steam trap into a condensate return system

steam trap: An automatic device that permits the discharge of condensate, air and other non-condensable gases from steam systems at or below saturated steam temperature and prevents or minimizes the discharge of live steam

steam trap station: device, which incorporates a universal steam trap connector with an integral inlet and outlet isolation valves, and may incorporate a strainer, blowdown valve, and test valve

4. Design, Layout, and Piping

4.1 General

4.1.1 All materials used in the design and installation of steam traps should be new and in accordance with this Practice and its references. See appropriate PIP piping material specifications and piping details.

4.1.2 Welded joints for pipe elements should be in accordance with ASME Boiler and Pressure Vessel Code, Section IX.

4.2 Design

4.2.1 Steam trap bodies should have a design pressure/temperature rating that is equal to or greater than the design conditions of the inlet pipe.

4.2.2 Materials of construction should be suitable for the application and consistent with local and external conditions related to corrosion and tensile strength.

4.2.3 The following information should be used for sizing steam traps:
   a. Condensate loads at start up and normal running conditions
   b. Steam inlet pressure and total condensate system backpressure
   c. Design conditions of the inlet pipe including maximum operating pressure and maximum operating temperature
   d. Application
   e. Equipment Process Data Sheet (if applicable)

4.2.4 Safety factors for sizing steam traps vary considerably. Consult steam trap manufacturers for their company’s recommended safety factors. Table 1 may be used for preliminary sizing purposes.
### 4.2.5 Application

For negative differential pressure or vacuum conditions, a pressure powered pump or pressure powered pump/steam trap combination should be considered. Pressure powered pump systems should include vacuum condensers and for stall conditions, heat exchangers. The sizing and installation details for pressure powered pumps are specific to each application and should be developed in consultation with the pump manufacturer.

### 4.3 Layout

**4.3.1** Typical steam trap locations are shown in the following list. Steam trap sizing and installation details for other locations should be developed in consultation with the steam trap manufacturer.

- a. Upstream of vertical risers and at low points of the distribution system
- b. At intervals of 45 m (150 ft) of horizontal steam lines
- c. Steam lines terminal points (e.g., end of mains)
- d. Upstream of pressure reducing valves, control valves, block valves and process equipment
- e. Steam tracers outlets
- f. Heat exchangers and process equipment outlets
- g. Steam turbine cases
- h. Steam coils outlets
- i. Steam jacket drains
- j. Steam distribution manifold drains
- k. Moisture separators
- l. Upstream of expansion joints, bends and raised expansion loops

**4.3.2** For freezing climates, steam traps should be resistant to damage from freezing or protected with freeze protection devices.

**4.3.3** Except for coils with siphon drain, steam traps should be installed below the equipment served and accessible for maintenance.
4.3.4 Steam traps should have one of the following configurations:
   a. Integral strainer with blowdown valve in accordance with *PIP PNSC0035*,
      drawing *PNSC0035-08*
   b. Separate Y-type strainer and blowdown valve in accordance with
      *PIP PNSC0035*, drawing *PNSC0035-07*

4.3.5 Steam traps discharging into elevated or pressurized condensate returns should
have a check valve installed downstream.

4.4 Piping

4.4.1 Steam Traps Discharging into Condensate Return Systems

4.4.1.1 Traps should have the following minimum auxiliary equipment:
   a. Upstream and downstream isolation valves
   b. For steam traps without integral strainers, strainer with blowdown valve
   c. Downstream check valve

4.4.1.2 Traps may be provided with any of the following optional auxiliary
   equipment:
   a. Upstream bleed valve
   b. Bypass line with globe valve
   c. Downstream test/depressurization valve

4.4.2 Steam Traps Discharging into Open Drains

4.4.2.1 Traps should have the following minimum auxiliary equipment:
   a. Upstream isolation valve
   b. For steam traps without integral strainers, strainer with blowdown valve

4.4.2.2 Traps may be provided with any of the following optional auxiliary
   equipment:
   a. A bypass globe valve.
   b. If multiple steam traps connect to a common discharge line before
      discharging to an open drain, a downstream isolation valve may be
      provided for each trap.
   c. If conditions exist for high velocity, blast type discharge (e.g.
      thermodynamic and inverted bucket steam traps are used), traps
      should have a diffuser that cushions the high velocity discharge and
      reduces noise and erosion.

4.4.3 If feasible, universal connector technology steam traps should be used. This
   technology can significantly reduce the time required to replace failed steam
   traps and is suitable for most drip and tracing applications, as well as small
   processes.
4.4.4 Lightweight steam trap stations that include isolation valves, and depressurization and test ports can be used for the steam trap installations described in Sections 4.4.1 and 4.4.2.

4.4.5 All condensate removal points should be individually trapped. Group trapping should not be permitted.

4.4.6 Steam distribution manifolds should be used to supply steam-tracing lines in close proximity in accordance with PIP PNSC0035, drawing PNSC0035-04. Steam distribution manifolds should be fabricated and provided in accordance with the following:
   a. Manifold body material, normalized carbon steel
   b. Welding in accordance with ASME Boiler and Pressure Vessel Code, Section IX
   c. Maximum operating pressure, 4140 kPag (600 psig) or greater at 260°C (500°F)
   d. Hydrotested by manifold fabricator in accordance with ASME B31.3
   e. 1-½ inches steam inlet connection
   f. ¾-inch NPT drain connection for condensate removal using a steam trap
   g. Unless otherwise specified, 4, 8 or 12 connections in ½- or ¾-inch NPT or SW
   h. May have isolation valves
   i. Support brackets
   j. Paint in accordance with PIP CTSE1000, for maximum temperature of 454°C (850°F)

4.4.7 Condensate collection manifolds should be used to collect condensate from steam tracing lines in close proximity in accordance with PIP PNSC0035, drawing PNSC0035-05. Condensate collection manifolds should be fabricated and provided in accordance with the following:
   a. Manifold body material, killed carbon steel
   b. Welding in accordance with ASME Boiler and Pressure Vessel Code, Section IX
   c. Hydrotested by manifold fabricator in accordance with ASME B31.3
   d. 1-inch discharge connection
   e. ¾-inch drain connection
   f. Unless otherwise specified, 4, 8 or 12 connections in ½- or ¾-inch NPT or SW
   g. Internal siphon pipe for even temperature distribution and freeze protection
   h. Support brackets
   i. Paint in accordance with PIP CTSE1000, for maximum temperature of 454°C (850°F)

4.4.8 If two or more traps are required to drain a piece of equipment, the traps should be installed in parallel. Each steam trap should be fitted with isolation valves,
strainer, and downstream check valve. Adequate spacing between steam traps should be provided for maintenance.

4.4.9 A bypass or drain line with a globe valve may be installed if a steam trap drains a piece of equipment that cannot be shut down to maintain the steam trap.

4.4.10 If a steam trap failure cannot be tolerated, a redundant steam trap should be installed in parallel.

4.4.11 Steam trap discharges should be directed to an appropriate condensate return.

4.4.12 If a condensate return system is not available, steam trap condensate should be discharged in accordance with local environmental regulations into a suitable dry well or French drain designed for the specific conditions of surrounding soil.

5. Selection

5.1 Steam trap selection should be based on the application, process conditions and pressure, and should include consultation with the steam trap manufacturer.

5.2 The following information should be obtained and used for steam trap selection:

a. Minimum and maximum steam pressure at the trap after pressure drop through upstream control valves or equipment

b. Backpressure

c. Quantity of condensate to be handled determined by any of the following methods:

   (1) Measurement

   (2) Calculation of heat load

   (3) Process equipment manufacturers’ data

d. Safety factor in accordance with Table 1

5.3 For existing condensate systems, a pressure survey of the condensate return header should be performed to verify the backpressure of the system.

5.4 Steam trap selection should be in accordance with Table 2.
Table 2. Steam Trap Selection

<table>
<thead>
<tr>
<th>Application</th>
<th>1st Choice</th>
<th>2nd Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Mains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>207 kPag (30 psig) or less</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>207 to 13790 kPag (30 to 2000 psig)</td>
<td>TD (Note 2)</td>
<td>IB</td>
</tr>
<tr>
<td>Superheated</td>
<td>TD</td>
<td>BM</td>
</tr>
<tr>
<td>Separators</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>Steam Tracers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Temp. &lt; 66°C (150°F)</td>
<td>BP</td>
<td>TD</td>
</tr>
<tr>
<td>Product Temp. &gt; 66°C (150°F)</td>
<td>TD</td>
<td>BP</td>
</tr>
<tr>
<td>Process Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 MPag (465 psig) or less</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>3.2 to 13.8 MPag (465 to 2,000 psig)</td>
<td>IB</td>
<td></td>
</tr>
<tr>
<td>Bulk Storage Tanks</td>
<td>BP</td>
<td>F&amp;T</td>
</tr>
<tr>
<td>Line Heaters</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>Process Vats</td>
<td>F&amp;T</td>
<td>TD</td>
</tr>
<tr>
<td>Vulcanizers</td>
<td>TD</td>
<td>F&amp;T</td>
</tr>
<tr>
<td>Evaporators</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>Reboilers</td>
<td>F&amp;T</td>
<td>IB</td>
</tr>
<tr>
<td>Rotating Cylinders</td>
<td>F&amp;T (Note 3)</td>
<td></td>
</tr>
<tr>
<td>Freeze Protection</td>
<td>LE</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. If the back pressure of an application is greater than 50% of the inlet pressure, thermodynamic steam traps should not be used.
2. If back pressure is greater than 50% of inlet pressure, IB or F&T should be used.
3. Steam lock release should be provided.

5.5 Pressure powered pumps should be used for negative differential pressure applications including vacuum. See Section 4.2.5 for design considerations.

### 6. Installation

6.1 Steam tracing traps should be installed in accordance with PIP PNSC0035.

6.2 The use of steam distribution manifolds and condensate collection manifolds is preferred for steam tracing applications.

6.3 For process applications, installation details should be developed with consultation from the steam trap manufacturer.
6.4 Steam traps should be installed near and below the condensate source, and in a location that is readily accessible for maintenance.

6.5 Inlet and discharge piping for steam traps should be in accordance with PIP Piping Material Specifications PN01CS1S02, PN 03CS1S02, and PN06CS1S01, and equal to or greater than the sizes of the steam trap connections.

6.6 Steam traps should discharge into non-pumped condensate headers. Discharges into pumped condensate headers should not be permitted.

6.7 Non-pumped condensate headers should be sized to limit the flash steam velocity to less than 20 m/s (4,000 ft/min). Header should be sloped in the direction of the flow a minimum of 1 cm per 24 m (1/2 inch per 100 ft) of straight pipe. Condensate should drain freely towards the condensate receiver or final destination. Vertical risers in non-pumped condensate headers should not be permitted.

6.8 For freezing conditions, condensate inlet and discharge piping shall be self-draining. If a self-draining pipe configuration is not feasible, steam trap freeze protection should be provided.