



Standard Specification for Steam Traps and Drains¹

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1. Scope

1.1 This specification² provides the minimum requirements for the design, fabrication, pressure rating, marking, and testing of steam traps and drains.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following safety hazards caveat pertains only to the test method portion of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ANSI Standards:³

- B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- B16.3 Malleable-Iron Screwed Fittings
- B16.4 Cast-Iron Screwed Fittings
- B16.5 Steel Pipe Flanges and Flanged Fittings
- B16.11 Forged Steel Fittings Socket-Welding and Threaded
- B16.15 Cast Bronze Screwed Fittings
- B16.18 Cast Bronze Solder-Joint Pressure Fittings
- B16.22 Wrought Copper and Bronze Solder-Joint Pressure Fittings
- B16.24 Bronze Flanges and Flanged Fittings
- B16.34 Steel Valves, Flanged and Butt-weld Ends
- B31.1 Power Piping

2.2 MSS Standards:⁴

- SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions
- SP-51 150 lb Corrosion Resisting Cast Flanges and Flanged Fittings

2.3 ASME Standards:⁵

- ANSI/ASME PTC 39.1 Condensate Removal Devices for Steam Systems
- ASME Boiler and Pressure Vessel Code, Section VIII Division I, Pressure Vessels
- ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *cold condensate capacity (QC)*—maximum mass of condensate that the steam trap/drain can discharge in 1 h at a given pressure and temperature, the trap/drain being fully open (lb/h (kg/h)).

3.1.2 *drain*—device having no moving parts permitting the discharge of fluids at a fixed or adjustable rate.

3.1.3 *hot condensate capacity (QH)*—maximum mass of condensate that a steam trap/drain can discharge in 1 h at a given pressure and temperature (lb/h (kg/h)).

3.1.4 *hydrostatic proof test (P_{THP})*—test used in determining maximum allowable pressure (PMA) and maximum allowable temperature (TMA) (lb/in.² (kg/mm²)).

3.1.5 *maximum allowable pressure (PMA)*—maximum pressure that the shell of the steam trap/drain can withstand permanently at a given temperature (lb/in.² (kg/mm²)).

3.1.6 *maximum allowable temperature (TMA)*—maximum temperature to which the shell of the steam trap/drain can be raised permanently (°F (°C)).

3.1.7 *maximum differential pressure (ΔP_{MX})*—maximum difference between operating pressure and operating back pressure (lb/in.² (kg/mm²)).

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² This specification was developed from Fluid Controls Institute Standards, 69-1 Pressure Rating Standards for Steam Traps and 85-1 Standard Production Test for Steam Traps.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, <http://www.mss-hq.com>.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

3.1.8 *maximum operating back pressure (PMOB)*—maximum permissible pressure measured at the outlet of the steam trap/drain allowing correct functioning (lb/in.² (kg/mm²)).

3.1.9 *maximum operating pressure (PMO)*—pressure for which a steam trap/drain is rated by the manufacturer.

3.1.9.1 *Discussion*—This pressure is normally a function of the limitations related to the internal mechanism of the steam trap/drain (lb/in.² (kg/mm²)).

3.1.10 *maximum test pressure (PTMX)*—maximum pressure applied to the steam trap/drain under test including its internal mechanism (lb/in.² (kg/mm²)).

3.1.11 *minimum differential pressure (ΔPMN)*—minimum difference between operating pressure and operating back pressure (lb/in.² (kg/mm²)).

3.1.12 *operating back pressure (POB)*—pressure measured at the outlet of the steam trap/drain under operating conditions (lb/in.² (kg/mm²)).

3.1.13 *operating differential pressure (ΔP)*—difference between the operating pressure and the operating back pressure (lb/in.² (kg/mm²)).

3.1.14 *operating pressure (PO)*—pressure measured at the inlet of the steam trap/drain under operating conditions (lb/in.² (kg/mm²)).

3.1.15 *operating temperature (TO)*—temperature measured at the inlet of the steam trap/drain under operating conditions (°F (°C)).

3.1.16 *performance characteristics tests*—tests carried out to determine the operational characteristics of a particular design of steam trap/drain.

3.1.17 *production tests*—tests carried out by the manufacturer to confirm that the steam trap/drain functions correctly.

3.1.17.1 *Discussion*—These tests may be witnessed by the purchaser or his representative. In this case, these tests are referred to as acceptance tests.

3.1.18 *steam trap*—self-contained valve that automatically drains the condensate from a steam containing enclosure while remaining tight to live steam, or if necessary, allowing steam to flow at a controlled or adjusted rate.

3.1.18.1 *Discussion*—Most steam traps will also pass non-condensable gases while remaining tight to live steam.

4. Ordering Information

4.1 Orders for products under this specification shall include the following information as applicable:

4.1.1 Performance characteristics required—See Section 7.

4.1.2 Certification of performance characteristics if required. See Section 7.

4.1.3 Nominal pipe size.

4.1.4 Maximum operating pressure, psig (kPa). See 3.1.5.

4.1.5 Capacity, lb/h (kg/h) (QC or QH). See 3.1.17 and 3.1.18.

4.1.6 Connection type (that is, threaded, socket weld, flanged). See 5.2.1.

4.1.7 *Materials*—external and internal.

4.1.8 Type of trap/drain.

4.1.9 Maximum test pressure, psig (kPa). See 3.1.12.

4.1.10 Maximum allowable pressure, psig (kPa). See 3.1.14.

4.1.11 Pressure differential (operating, maximum, or minimum, or combination thereof).

4.1.12 *Notice for Acceptance Test*—If the purchaser wishes to witness the production tests, this shall be specified in the order. See 8.2.

5. Materials and Manufacture

5.1 Materials:

5.1.1 The pressure ratings established under this specification are based upon materials of high quality produced under regular control of chemical and mechanical properties by a recognized process. The manufacturer shall be prepared to certify that his product has been so produced and that the mechanical and chemical properties thereof, as proved by test specimens and nondestructive testing or as documented by certifications from the producer or recognized distributor of these materials, are at least equal to the requirements of the appropriate specifications.

5.1.2 Housings of traps/drains, and other parts or bolting, or combination thereof, used for pressure retention, shall be constructed of materials in accordance with ANSI/ASME B31.1 or Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

5.1.3 Seals and parts, in addition to pressure containing parts and bolting used for pressure retention, shall be of materials suitable for the service.

5.1.4 Users are cautioned against applications with fluids that may react chemically with any materials used in these products.

5.1.5 For materials not having values of allowable stress tabulated in Section VIII, Division 1, allowable stresses shall be determined in accordance with the procedures outlined in Subsection C and Appendix P of Section VIII of the ASME Boiler and Pressure Vessel Code. Where it can be shown that the values of allowable stress listed for a particular material in one product form (because of similar chemistry, mechanical properties, directional properties, heat treatment, and so forth) are applicable to the same material in an unlisted product form, the listed values of allowable stress may be used.

5.2 Manufacture:

5.2.1 Steam traps/drains with end fittings in compliance with the following standards may be used within the pressure-temperature ranges permitted by the applicable standard provided the trap/drain housing (less end fittings) is satisfactory for these conditions:

5.2.1.1 ANSI B16.1,

5.2.1.2 ANSI B16.3,

5.2.1.3 ANSI B16.4,

5.2.1.4 ANSI B16.5,

5.2.1.5 ANSI B16.11,

5.2.1.6 ANSI B16.15,

5.2.1.7 ANSI B16.18,

5.2.1.8 ANSI B16.22,

5.2.1.9 ANSI B16.24,

5.2.1.10 ANSI B16.34, and

5.2.1.11 MSS SP-51.

5.2.2 Weld design details, welding, and nondestructive testing shall be in accordance with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. Welders and weld procedures shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

6. Requirements

6.1 Pressure Rating and Design:

6.1.1 The maximum allowable pressure (PMA) and maximum allowable temperature (TMA) rating for steam traps/drains conforming to this specification shall be established by at least one of the following methods:

6.1.1.1 Proof test in accordance with the requirements prescribed in paragraph UG-101 of Section VIII of the ASME Boiler and Pressure Vessel Code. If burst-type tests as outlined in UG-101(m) are used, it is not necessary to rupture the component. In this case, the value of “B” to be used in determining the maximum allowable pressure shall be the maximum pressure to which the component was subjected without rupture. Safety of personnel shall be given serious consideration when conducting hydrostatic tests. Components that have been subjected to a hydrostatic proof test shall not be offered for sale.

6.1.1.2 Design calculations in accordance with the requirements prescribed in Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

6.1.1.3 Hydrostatic proof test of a representative production sample to establish the maximum allowable pressure (PMA) and maximum allowable temperature (TMA) rating as described in 8.1.

6.1.1.4 Extensive and successful performance experience under comparable service conditions with similarly proportioned components of the same or similar material may be used as a basis for rating provided all other provisions of this specification are met.

6.2 Production Tests:

6.2.1 The manufacturer shall production test every steam trap/drain as described in Section 8 by one of the following test methods:

6.2.1.1 *Hydrostatic*—See 8.2.

6.2.1.2 *Steam*—See 8.3.

6.2.1.3 *Air*—See 8.4.

6.2.2 Samples of the traps/drains shall be visually examined and dimensionally checked to ensure that the traps/drains correspond to this specification and are marked in accordance with Section 9.

6.2.3 Sample steam traps/drains shall be given an operational check steam test to ensure that they open to discharge condensate and close satisfactorily in accordance with 8.5. This test does not apply to labyrinth (orifice) steam traps/drains.

7. Performance Characteristics

7.1 A manufacturer may describe the operation of a particular type of steam trap or drain by referring to one or more of the performance characteristics. When this is done, the associated tests described in 8.6 must be performed on a representative production sample. A brief explanation of the derivation of

each characteristic is given as follows. Further details on test methods are specified in Section 8.

7.1.1 Certification of performance characteristics shall be available if required by the purchaser (see 4.1.2).

7.2 *Minimum Operating Pressure*—The steam trap shall be tested to determine the minimum pressure (atmospheric or above) at which correct opening and closing will occur.

7.3 *Maximum Operating Pressure (PMO)*—The steam trap shall be tested to determine the maximum pressure at which correct opening and closing will occur.

7.4 *Maximum Operating Back Pressure (PMOB)*—The steam trap shall be tested to determine the maximum pressure permissible at the outlet of the device that allows correct functioning.

7.5 *Air Venting Capability*—The steam trap/drain shall be tested to determine its ability to discharge air and other noncondensable gases.

7.6 *Operating Temperature (TO)*—The steam trap/drain shall be tested to determine the temperature at which the device operates and, in particular, the temperature at which it passes its specified capacity.

7.7 *Condensate Capacity (QH or QC)*—The steam trap/drain shall be flow tested to determine its condensate capacity throughout its operating pressure range.

7.8 *Live Steam Loss*—The steam trap shall be tested to determine the amount of live steam lost through the trap.

8. Test Methods

8.1 *Hydrostatic Proof Test*—Establish the maximum allowable pressure (PMA) and temperature (TMA) rating using a hydrostatic proof test of a representative production sample, chosen in accordance with 6.1.1.3 and perform as follows:

$$\begin{aligned}
 PMA = & \frac{PTH P(f)}{5} \\
 & \times \frac{\text{specified minimum tensile strength}}{\text{average tensile of test specimens of pressure retaining components}} \\
 & \times \frac{\text{stress value at design temperature}}{\text{stress value at test temperature}}
 \end{aligned}$$

8.1.1 Determine stress values in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code or ANSI B31.1.

8.1.2 Casting quality factor (*f*) shall be 1.0 for wrought materials and 0.8 for castings.

8.1.3 Gasket leakage during test does not constitute failure unless a result of rupture of a pressure containing part.

8.1.4 Do not exceed water temperature of 125°F (50°C) during the test.

8.1.5 Retain certification of the hydrostatic proof test by the manufacturer and make available upon request.

8.2 *Hydrostatic Production Shell Test*—Give steam traps/drains a hydrostatic shell test at a pressure of 1.5 times its maximum allowable pressure rating at 68°F (20°C).

8.2.1 Do not exceed water temperature of 125°F (50°C) during the hydrostatic test.

8.2.2 The minimum duration of the shell test shall be as follows:

Nominal Pipe Size	Duration
1/8 through 2 (6-50 mm)	15 s
2 1/2 through 8 (65-200 mm)	1 min
10 and over (250 mm)	3 min

8.2.2.1 Because of the complexity of product shape and size, the duration of the hydrostatic test may vary, but in no case shall this duration be less than that given in 8.2.2.

8.2.3 No visible leakage through pressure boundary walls or structural damage shall be evident during the shell tests.

8.3 *Steam Production Shell Test*—Test steam traps and drains no larger than 2-in. (50-mm) pipe size on saturated steam at their maximum operating pressure but not to exceed 250 psig (1820 kPa).

8.3.1 The minimum duration of the shell test shall be 15 s.

8.3.2 If this option is exercised, the manufacturer shall be able to certify that a prototype from each production lot of the same size steam trap/drain tested in this manner was subjected to a hydrostatic shell test in accordance with 8.2.

8.3.3 Show no visible leakage or structural damage during the shell tests.

8.4 *Air Production Shell Test*—Test traps and drains no larger than 2-in. (50-mm) pipe size for shell leaks on air at ambient temperature and 80 psi (551 kPa).

8.4.1 The minimum duration of the shell test shall be 15 s.

8.4.2 If this option is exercised, the manufacturer shall be able to certify that a prototype from each production lot of the same size steam trap/drain tested in this manner was subjected to a hydrostatic shell test in accordance with 8.2.

8.4.3 Visually detectable leakage through the pressure retaining walls is not acceptable.

8.5 *Operational Check Steam Test*—Feed the steam trap with steam and introduce condensate intermittently. When only steam is present, the steam trap shall close. On the introduction of condensate, the steam trap shall open (the time taken will vary as a function of the steam trap type). When the condensate has been discharged, the steam trap shall close again when steam enters the trap. The test is satisfied when at least one complete cycle has been performed.

8.6 *Performance Characteristics Tests:*

8.6.1 *Determination of Minimum Operating Pressure*—Carry out operational checks, as described in 8.5, while successively reducing the test pressure until the steam trap fails to open and close correctly. The minimum operating pressure is the lowest test pressure at which correct operation is observed.

8.6.2 *Determination of Maximum Operating Pressure*—Verify the maximum operating pressure of the steam trap by carrying out operational checks, as described in 8.5, while successively increasing the test pressure up to the steam trap's maximum operating pressure. The steam trap shall open and close correctly throughout the test.

8.6.3 *Determination of Maximum Operating Back Pressure*—Carry out operational checks, as described in 8.5, with the outlet from the steam trap connected to a vessel in which the pressure can be raised, independent of the test pressure upstream of the steam trap. While maintaining a

reference pressure at the steam trap inlet, successively raise the pressure at its outlet until the steam trap fails to open and close correctly. The maximum operating back pressure is the highest pressure applied to the steam trap outlet at which correct operation is still observed.

8.6.4 *Determination of Air Venting Capability*—Introduce air at a specified temperature into the trap or upstream piping. Check the air venting capability by an air flow measurement carried out at minimum and maximum operating pressure. Record the temperature at the trap inlet.

8.6.5 *Determination of Operating Temperature*—Feed steam into the steam trap to effect closure. Introduce condensate, at saturation steam temperature, and, unless the steam trap opens immediately, allow to cool slowly at the steam trap's inlet. The operating temperature is the temperature of the condensate, measured at the inlet to the trap, at which the trap opens sufficiently to pass its specified capacity.

8.6.6 *Determination of Condensate Capacity*—Determine the capacity of the steam trap/drain by measuring the amount of condensate that is discharged from the device under specified conditions of pressure, pressure differential, and condensate temperature. Carry out the test with condensate at different temperatures and at different pressure within the steam trap/drain's operating range in accordance with ANSI/ASME PTC 39.1.

8.6.7 *Determination of Live Steam Loss*—Use several methods to determine the amount of live steam lost, if any, by the steam trap/drain in accordance with ANSI/ASME PTC 39.1.

9. Product Marking

9.1 Each steam trap/drain shall as a minimum be permanently marked with the following information:

9.1.1 Manufacturer's name or trademark.

9.1.2 Maximum operating pressure (PMO) or maximum differential pressure (Δ PMX) rating.

9.1.3 Maximum allowable pressure (PMA).

9.1.4 Indication of flow direction (arrow or word "inlet" or "outlet," or both).

9.1.5 ASTM designation of this specification.

9.2 Flanges, butt welding, threaded, or other ends complying with a standard listed in 5.2.1 may be marked in accordance with the applicable requirements of MSS SP-25 for dimensional identification purpose if desired.

9.3 *Omission of Markings on Trap/Drain Body*—On traps/drains whose size or shape limit the markings, markings shall be applied on an identification plate securely attached to the body. In no case shall the markings be hidden by the fixing elements of the steam trap.

9.4 *Additional Markings*—A manufacturer having complied with the requirements of Section 9 may include the following:

9.4.1 Mark any of the above mentioned items in more than one place, for example, if any item is marked on the body, it may also be repeated on an identification plate; or

9.4.2 Add any other markings, for example, catalog item numbers, providing that there is no risk of confusion between these markings and those mentioned in Section 9.

10. Quality Control

10.1 The trap/drain manufacturer shall maintain the quality of the traps/drain that are designed, tested, and marked in accordance with this specification. At no time shall a trap/drain be sold with this specification designation that does not meet the requirements herein.

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11. Keywords

11.1 fluid discharge; steam drains; steam traps; valve