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Automatic steam traps — Production and performance characteristic tests

Purgeurs automatiques de vapeur d'eau — Essais de production et essais des caractéristiques de fonctionnement

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 153, *Valves*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO 6948:1981, ISO 7841:1988 and ISO 7842:1988, which have been technically revised.

The main changes are as follows:

— merging of ISO 6948:1981, ISO 7841:1988 and ISO 7842:1988;

— update of the technical content according to state-of-the-art;

— addition of the terminological entry on subcooling (3.2);

— addition of a data sheet for test methods A and B on steam trap discharge capacity in A.3.3 and in A.4.3;

— addition of a computation formula [Formula (B.4)];

— addition of a data sheet for test methods A and B on steam loss test in B.3.4 and B.4.4.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Testing of steam traps provides conformance of product performance to the intended function. This document addresses the requirements for production testing and performance testing of steam traps. Production test ensures the shell integrity to the maximum working pressure while the performance test ensures the functional requirement of steam traps. Performance test should be considered as type test.

Testing is the most reliable method to validate a product including design, material selection and manufacturing processes. It may also serve as a guide for steam traps selection. It can allow the users to compare different types of steam traps, designs and brands.

Currently the test requirements are mostly driven by the manufacturer or the users and each may have their own specification. This document will create common understanding on the qualifications, and end-user total cost-of-ownership by eliminating unintentional design flaws and planned obsolescence.

Ultimately, this document will improve performance and safety in the plants by enabling any customer to specify durable type-tested industrial valves.

Automatic steam traps — Production and performance characteristic tests

1 Scope

This document specifies the production and performance relevant test requirements for automatic steam traps used for condensate removal/recovery services for optimized utilization of energy, in refinery, power generation or other general applications where steam is used as a medium of heat transfer.

The tests can be classified as production tests and performance characteristic tests and can be conducted to ensure the correct functioning of a steam trap or to evaluate the performance of a particular design. This document specifies the tests performed relative to each one of these two categories and briefly describes the corresponding test methods.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6553, *Automatic steam traps — Marking*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
production test
tests carried out by the manufacturer to confirm that each automatic steam trap functions correctly

Note 1 to entry: These tests may be witnessed by the purchaser or his representative. In this case, these tests are referred to as acceptance tests.

3.2
subcooling
temperature-related phenomenon which is the difference between the steam saturation temperature to the actual temperature of steam/condensate either at steam trap inlet or exit

Note 1 to entry: This may be the accountable parameter in some of the steam trap type like thermostatic steam traps.

Note 2 to entry: The water with a temperature value below the saturation temperature is called the subcooled condensate. But also, the saturation temperature always corresponds to the pressure at which the system is operating.

4 Test methods

4.1 Production test — Shell testing

Each steam trap shall be tested to confirm the integrity of its shell under pressure.

The test fluid, the choice of which is left to the discretion of the manufacturer, shall be either:

— water, which may contain a corrosion inhibitor, kerosene or any other suitable liquid having a viscosity not greater than that of water;

— steam, air, or any other suitable gas.

NOTE Various statutory authorities require specific approval of test procedures where the test is conducted using steam, air, or other gas.

Any internal trim which does not withstand the test pressure may be removed before the test.

The steam trap shall be essentially vented off air when testing with a liquid.

Steam traps shall not be painted or otherwise coated with materials capable of sealing against leakage before the shell pressure tests are completed. Chemical corrosion protection treatments and internal linings are permitted. If pressure tests in the presence of a representative of the purchaser are specified, painted steam traps from stock may be re-tested without removal of paint.

Test equipment shall not subject the steam trap to externally applied stresses which can affect the results of the tests.

The shell test shall be performed by applying pressure inside the assembled steam trap with the ends closed.

For all steam traps, the hydraulic shell test shall be performed at a pressure 1,5 times the maximum allowable pressure at 20 °C.

For steam traps with a nominal diameter less than or equal to DN 50 and with pressure range up to PN 40 or Class 300, a hydraulic shell test can be performed using gas at a pressure (gauge pressure) of 6 bar (0,6 MPa). For gas test, safety measures shall be taken.

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

Test durations shall not be less than those specified in Table 1.

Table 1 — Minimum durations for shell tests

Nominal steam trap size DN	Minimum test duration [s]
DN ≤ 50	15
65 ≤ DN ≤ 200	60
250 ≤ DN	180

4.2 Performance characteristic tests

4.2.1 Operational check

The operational performance of the steam trap shall be checked under the steam and condensate. The test set up shall produce the steam and condensate in the desired condition. Steam shall be fed into the steam trap. Condensate shall be introduced intermittently if required.

When only steam is present, the steam trap shall close. When the steam becomes 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 again close. The test is complete when at least one complete cycle has been performed. The condensate can also be fed to the steam trap to quicken the cycle and to verify the performance.

Certain types of steam trap may be tested with air or water.

A manufacturer may describe the operations of a particular type of steam trap by referring to one or more of the following performance characteristic tests. A brief explanation of the derivation of each characteristic is given below.

The performance test may be considered on sample basis as type test based on the type of steam traps. Sample steam traps shall be tested to ensure that they open to discharge condensate and close satisfactorily. Further details are given in 4.2.2 to 4.2.15. This test does not apply to the labyrinth (or orifice) steam traps (see ISO 6704).

4.2.2 Minimum operating pressure

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

4.2.3 Maximum operating pressure (PMO)

The steam trap shall be tested to determine the maximum pressure at which the correct opening and closing will occur.

4.2.4 Maximum operating back pressure (PMOB)

The steam trap shall be tested to determine the maximum pressure permissible at the outlet of the device which allows correct functioning.

4.2.5 Air venting capability

The steam trap shall be tested to determine its ability to discharge air.

4.2.6 Operating temperature (TO)

The steam trap shall be tested to determine the temperature at which the device operates and in particular the temperature at which it passes its specified capacity.

4.2.7 Condensate capacity (QH or QC)

The steam trap shall be flow tested to determine its condensate capacity throughout its operating pressure range.

4.2.8 Live steam loss

The steam trap shall be tested to determine the amount of live steam lost via the steam trap.

4.2.9 Determination of minimum operating pressure

Operational checks, as described in 4.2.1, shall be carried out 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.

4.2.10 Determination of maximum operating pressure

The maximum operating pressure of the steam trap may be verified by carrying out operational checks, as described in 4.2.1, 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.

4.2.11 Determination of maximum operating back pressure

Operational checks, as described in 4.2.1, shall be carried out 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's inlet, the pressure at its outlet is to be raised successively until the steam trap fails to open and close correctly.

The maximum operating back pressure is the highest pressure applied to the steam trap's outlet at which correct operation is still observed.

4.2.12 Determination of air venting capability

Air shall be introduced at a specified temperature into the steam trap or upstream piping. The air venting capability shall be checked by an air flow measurement carried out at minimum and maximum operating pressures, the temperature inside the steam trap being recorded.

4.2.13 Determination of operating temperature

Steam shall be fed into the steam trap to effect closure. Condensate, at saturated steam temperature, shall then be introduced and, unless the steam trap opens immediately, shall be allowed to cool slowly at the steam trap's inlet.

The temperature of the condensate, measured at the steam trap's inlet, at which the device opens, is the operating temperature.

The operating temperatures are the temperatures of the condensate, measured at the inlet to the steam trap, at which the steam trap passes its specified capacities.

4.2.14 Determination of condensate capacity

The capacity of the steam trap shall be determined by measuring the amount of condensate that is discharged from the device under specified conditions of pressure differential and condensate temperature.

The test shall be carried out with condensate at different temperatures and at different pressures within the steam trap's operating range to be specified, according to the test requirements detailed in Annex A.

4.2.15 Determination of live steam loss

To determine the amount of live steam lost, if any, by the steam trap, use one of the test methods in Annex B.

5 Inspection

Samples of the finished steam traps shall be visually examined and dimensionally checked to ensure that the steam traps correspond to the stated specification and shall be marked in accordance with ISO 6553.

Annex A
(normative)

Test methods for the determination of discharge capacity

A.1 General

This annex specifies two test methods to determine the discharge capacity of automatic steam traps.

A.2 Test arrangements

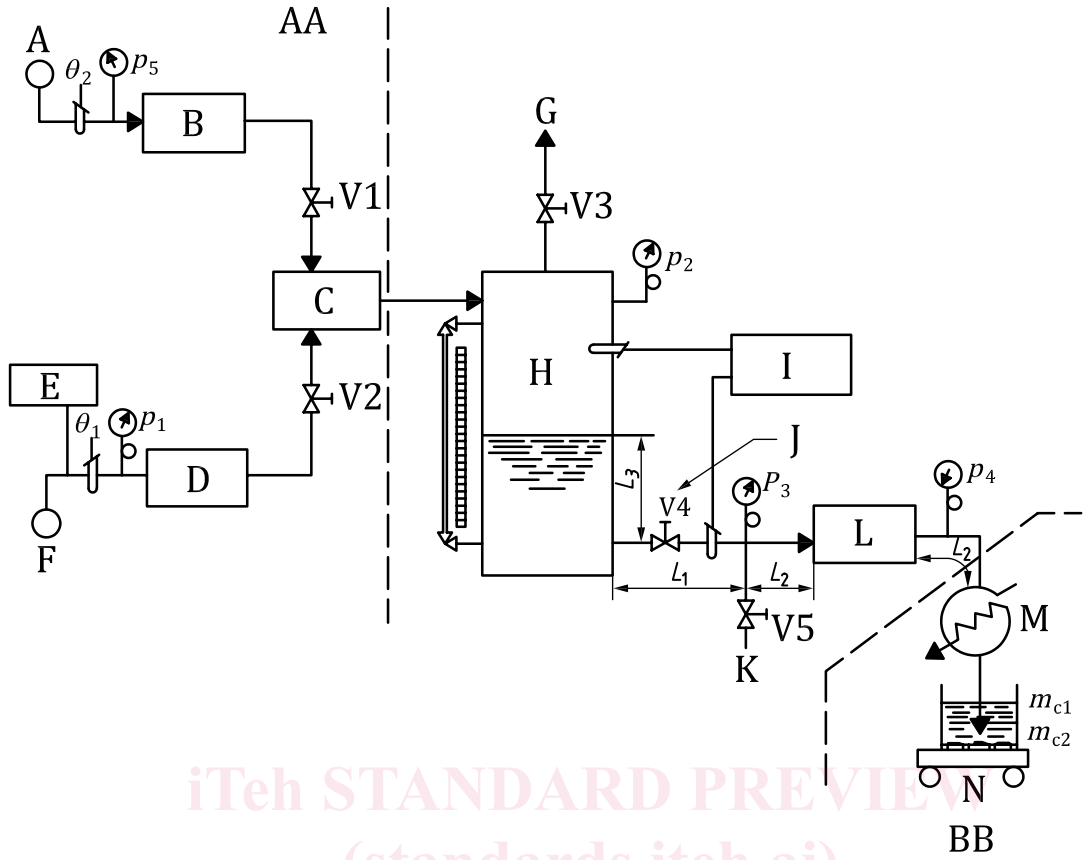
The test arrangements for condensate capacity determination are shown in Figures A.1 and A.2.

To reduce thermal losses to a minimum, all piping and equipment shall be insulated to a value R, in $m^2 \cdot °C \cdot h \cdot J^{-1}$, according to Formula (A.1).

$$R \geq 0{,}75 \times 10^{-3} \tag{A.1}$$

The instruments used for the measurements shall comply with International Standards, for example, ISO 4185, the ISO 5167 (series) and ISO 5168 for flow measurements.

The condensate removal device shall not be modified in any way from its commercial form.



Key

A	water supply	L	test device
B	flow meter q_{m1}	M	water-cooled condenser
C	steam water mixer	N	scale
D	flow meter q_{m2}	V1	valve 1
E	calorimeter	V2	valve 2
F	steam supply	V3	valve 3
G	steam vent	V4	valve 4
H	flash tank accumulator	V5	valve 5
I	temperature difference indicator $\Delta\theta$	AA	arrangement A
J	gate or full bore valve V4	BB	arrangement B
K	drain		

NOTE 1 The diameter of the pipework from the accumulator to the condensate removal device is the same as, or greater than, the diameter of the pipework to the inlet connection on the device.

NOTE 2 The distance L_1 does not exceed 10 internal pipe diameters.

NOTE 3 The distance L_2 is not less than 10 and not more than 20 internal pipe diameters.

NOTE 4 The distance L_3 is measured vertically from the water level to the centre of the inlet connection of the test device.

Figure A.1 — Test arrangement for test method A