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## Testing of valves — Fire type-testing requirements

*Essais des appareils de robinetterie — Exigences de l'essai au feu*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10497 was prepared by Technical Committee ISO/TC 153, Valves, Subcommittee SC 1, *Design, manufacture, marking and testing*.

This third edition cancels and replaces the second edition (ISO 10497:2004), which has been technically revised.

## Introduction

This International Standard covers the requirements and method for evaluating the performance of valves when they are exposed to defined fire conditions. The performance requirements establish limits of acceptability of a valve, regardless of size or pressure rating. The burn period has been established to represent the maximum time required to extinguish most fires. Fires of longer duration are considered to be of major magnitude, with consequences greater than those anticipated in the test.

The test pressure during the burn is set at 0,2 MPa (2 bar) for soft-seated valves rated PN 10, PN 16, PN 25 and PN 40, Class 150 and Class 300, to better simulate the conditions that would be expected in a process plant when a fire is detected and pumps are shut down. In this case, the source of pressure in the system is the hydrostatic head resulting from liquid levels in towers and vessels. This situation is approximated by this lower test pressure.

In production facilities, valves are typically of a higher rating and the pressure source is not easily reduced when a fire is detected. Therefore, for all other valves, the test pressure during the burn is set at a higher value to better simulate the expected service conditions in these facilities.

Use of this International Standard assumes that the execution of its provisions is entrusted to appropriately qualified and experienced personnel, because it calls for procedures that can be injurious to health, if adequate precautions are not taken. This International Standard refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage of the procedure.

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# Testing of valves — Fire type-testing requirements

## 1 Scope

This International Standard specifies fire type-testing requirements and a fire type-test method for confirming the pressure-containing capability of a valve under pressure during and after the fire test. It is not applicable to the testing requirements for valve actuators other than manually operated gear boxes or similar mechanisms when these form part of the normal valve assembly. Other types of valve actuators (e.g. electrical, pneumatic or hydraulic) can need special protection to operate in the environment considered in this valve test, and the fire testing of such actuators is outside the scope of this International Standard.

Fire test certificates of valves previously tested according to previous editions of ISO 10497 and to similar internationally recognized fire test standards are also acceptable.

NOTE For the purposes of this International Standard, the terms “fire type-test” and “fire test” are synonymous.

## 2 Normative references

The following referenced documents are indispensable for the application 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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

IEC 60584-2, *Thermocouples — Part 2: Tolerances*

## 3 Terms and definitions

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

### 3.1

#### **nominal size**

#### **DN**

alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

NOTE Adapted from ISO 6708:—, definition 2.1.

### 3.2

#### **nominal pressure**

#### **PN**

numerical designation relating to pressure which is a convenient rounded number for reference purposes, and which comprises the letters PN followed by the appropriate reference number

NOTE 1 It is intended that all equipment of the same nominal size (DN) designated by the same PN number have compatible mating dimensions.

NOTE 2 The maximum allowable pressure depends on materials, design and working temperatures, and is selected from the tables of pressure/temperature ratings given in the appropriate standards.

NOTE 3 Adapted from ISO 7268:—, Clause 2.1.

### 3.3

#### **NPS**

alphanumeric designation of size for components of a pipework system, which is used for reference purposes, and which comprises the letters NPS followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connections

NOTE The number following the letters NPS does not represent a measurable value and is not intended to be used for calculation purposes except where specified in the relevant standard.

### 3.4

#### **class**

alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system, which comprises the word "Class" followed by a dimensionless whole number

NOTE The number following the word "Class" does not represent a measurable value and is not intended to be used for calculation purposes except where specified in the relevant standard.

### 3.5

#### **symmetric seated valve**

valve with an internal construction, which has a plane of symmetry perpendicular to the axis of the body ends

NOTE This is a valve where both seat and sealing elements are identical.

### 3.6

#### **asymmetric seated valve**

valve with an internal construction, which has no plane of symmetry perpendicular to the axis of the body ends

NOTE This is a valve with a single seat offset from the shaft centreline.

### 3.7

#### **soft seat**

#### **soft seal**

seat or sealing element made from, or including, a significant amount of thermoplastic or elastomeric material

## 4 Test conditions

### 4.1 Direction and conditions for valves to be tested

4.1.1 Symmetric seated valves intended by the manufacturer for bi-directional installation shall be tested in one direction only.

4.1.2 Asymmetric seated valves intended by the manufacturer for bi-directional installation shall be tested by carrying out the burn test procedure twice, once in each direction of the potential installation.

The same valve may be refurbished and re-tested, or another, identical, valve may be tested in the other direction.

4.1.3 Valves intended solely for unidirectional installation shall be clearly and permanently marked as such, and shall be tested in the stated direction of installation.



**4.1.4** If the valve being tested is fitted with a gearbox or other such manual device, only that particular assembly shall qualify. If a valve can be supplied with or without a gearbox, testing with a gearbox fitted shall qualify valves without a gearbox, but not the converse.

**4.1.5** Valves (and gearboxes) shall not be protected with insulation material of any form during testing, except where such protection is part of the design of the component(s).

## **4.2 Pressure relief provision**

If the valve under test incorporates a pressure relief device as part of its standard design and if this device activates during the fire test, the test shall be continued and any leakage to atmosphere from the device shall be measured and counted as external leakage. If the design is such that the device vents to the downstream side of the valve, any leakage shall be counted as through-seat leakage (see 5.6.11 and 5.6.13).

However, the test shall be stopped if the system pressure relief device described in 5.3.2.8 activates.

## **5 Fire test method**

### **5.1 General warning**

Fire testing of valves is potentially hazardous and it is essential that the safety of personnel be given prime consideration. Given the nature of the fire test and the possibility of weaknesses in the design of the test valve and test equipment, hazardous rupture of the pressure boundary could occur. Adequate shields in the area of the test enclosure and other appropriate means for the protection of personnel are necessary.

### **5.2 Principle**

A closed valve, completely filled with water under pressure, is completely enveloped in flames with an environmental temperature in the region of the valve of 750 °C to 1 000 °C for a period of 30 min. The objective is to completely envelop the valve in flames to assure that the seat and sealing areas are exposed to the high burn temperature. The intensity of the heat input shall be monitored using thermocouples and calorimeter cubes as specified in 5.6.7 and 5.6.8. During this period the internal and external leakage is recorded. After cool-down from the fire test, the valve is hydrostatically tested to assess the pressure-containing capability of the valve shell, seats and seals.

### **5.3 Apparatus**

#### **5.3.1 General**

The test equipment shall not subject the valve to externally applied stress affecting the results of the test.

Schematic diagrams of recommended systems for fire type-testing of valves are given in Figure 1.

Potential pipework-to-valve end connection joint leakage is not evaluated as part of the test and is not included in the allowable external leakage (see 6.3 and 6.6). For the purposes of this test, it may be necessary to modify these joints to eliminate leakage.

The test equipment shall be designed such that if the nominal diameter of the pipework situated immediately upstream of the test valve is larger than DN 25 or one-half the DN of the test valve, the pipework shall be enveloped in flames for a minimum distance of 150 mm from the test valve. The diameter of the upstream pipework shall be sufficient to deliver a flow rate in excess of the maximum allowable leak rate for the size of the valve being tested.

The pipework downstream of the test valve shall be at least DN 15 and shall be inclined such that the downstream side is fully drained.

The flame source shall be at least 150 mm minimum away from the valve or any calorimeters, and should have sufficient capacity to completely envelop the valve in flames.

The enclosure containing the valve shall provide a horizontal clearance of a minimum of 150 mm between any part of the test valve and the enclosure, and the height of the enclosure above the top of the test valve shall be a minimum of 150 mm.

### 5.3.2 Specific apparatus

**5.3.2.1 Vapour trap**, to minimize the cooling effect of the upstream liquid. See Figure 1 (7).

NOTE In 5.3.2 and 5.6, the numbered items in parentheses refer to the item numbers for the apparatus in Figure 1.

**5.3.2.2 Industrial pressure measurement devices** having a full-scale reading of between 1,5 and 4 times the pressure being measured. The accuracy of each test device used at any point on the scale shall be within 3 % of its maximum scale value for readings taken both up and down the scale, with either increasing or decreasing pressure. See Figure 1 (6, 12).

**5.3.2.3 Calorimeter cubes**, of carbon steel in accordance with the design and dimensions shown in Figure 2, with a thermocouple of the accuracy specified in 5.3.2.4, located in the centre of each cube. Calorimeter cubes shall be scale-free before exposure to the fire environment.

**5.3.2.4 Flame environment and valve body thermocouples**, of an accuracy at least equal to tolerance class 2 for type B or tolerance class 3 for other types, as specified in IEC 60584-2. See Figure 1 (11).

**5.3.2.5 Containers**, of a size suitable for collecting the water leaked from the valve under test. See Figure 1 (16).

**5.3.2.6 Calibrated sight gauge**, or device for measuring the water used during the test. See Figure 1 (4).

**5.3.2.7 Calibrated device for measuring the leakage water** collected during the test.

**5.3.2.8 Pressure relief provision**, incorporated in the system, consisting of a **pressure relief valve** to relieve the test valve centre cavity pressure to the atmosphere, to protect against potential rupture of the valve, if it is designed such that liquid can be trapped in the cavity. See Figure 1 (12).

The pressure relief valve setting shall be

- either that determined by the valve manufacturer from data obtained by hydrostatic pressure testing of valves of the same size and type as the fire-tested valve, or
- when pressure test data are not available, a setting not greater than 1,5 times the maximum allowable pressure at 20 °C.

### 5.4 Test fluid

The test fluid used shall be water.

### 5.5 Test fuel

The test fuel shall be gaseous.

### 5.6 Procedure

NOTE The numbered items in parentheses refer to the item numbers for the apparatus in Figure 1.

**5.6.1** Mount the test valve in the test apparatus such that the stem and bore of the valve are in the horizontal position. Mount a valve that operates in only one direction (unidirectional) in their normal operating position.

Locate the flame environment, body thermocouples and calorimeter cubes in the positions shown in Figures 3 and 4, as appropriate.

For soft-seated valves up to DN 100 or NPS 4 and pressure ratings up to PN 40, Class 300, use two flame environment thermocouples, two body thermocouples and two calorimeter cubes as shown in Figure 3.

For all other valves, use two flame environment thermocouples and two calorimeter cubes as shown in Figure 4. For valves DN 200 or NPS 8 and larger, use a third calorimeter cube as shown in Figure 4.

**5.6.2** With the test valve in the partially open position, open the water supply valve, the shut-off valve (5), the vent valves (14) and the shut-off valve (13) to flood the system and purge the air. When the system is completely filled with water, close the shut-off valve (13), the vent valves (14) and the water supply valve. Pressurize the system with water to a test pressure of 1,4 times the maximum allowable pressure at 20 °C; the actual test pressure may be rounded up to the next highest bar<sup>1)</sup>. Check for leaks in the test apparatus and eliminate as necessary. Release the pressure, close the test valve and open the shut-off valve (13).

**5.6.3** If the valve under test is of the upstream sealing type, determine the volume of water that is trapped between the upstream seat seal and the downstream seat seal when the valve is closed. Record this volume.

It is assumed that, during the fire type-test, this volume of water would flow through the valve and pass the downstream seat seal to be collected in the container (16). Since this volume has not actually leaked through the upstream seat seal, it is deducted from the total volume collected in the downstream container when determining the through-seat leakage (see 5.6.11).

**5.6.4** Pressurize the system to one or the other of the following pressures, as appropriate:

- a) for soft-seated valves rated PN 10, PN 16, PN 25 and PN 40, Class 150 and Class 300, the low test pressure at 0,2 MPa (2 bar);
- b) for all other valves, the high test pressure at 75 % of the maximum allowable seat pressure at 20 °C.

Tolerance on all test pressures is  $\pm 10$  %.

Maintain this test pressure during the burn and cool-down periods, momentary pressure losses of up to 50 % of the test pressure being permitted provided that the pressure recovers within 2 min and the cumulative duration is less than 2 min.

**5.6.5** Record the reading on the calibrated sight gauge or device (4). Empty the container (16).

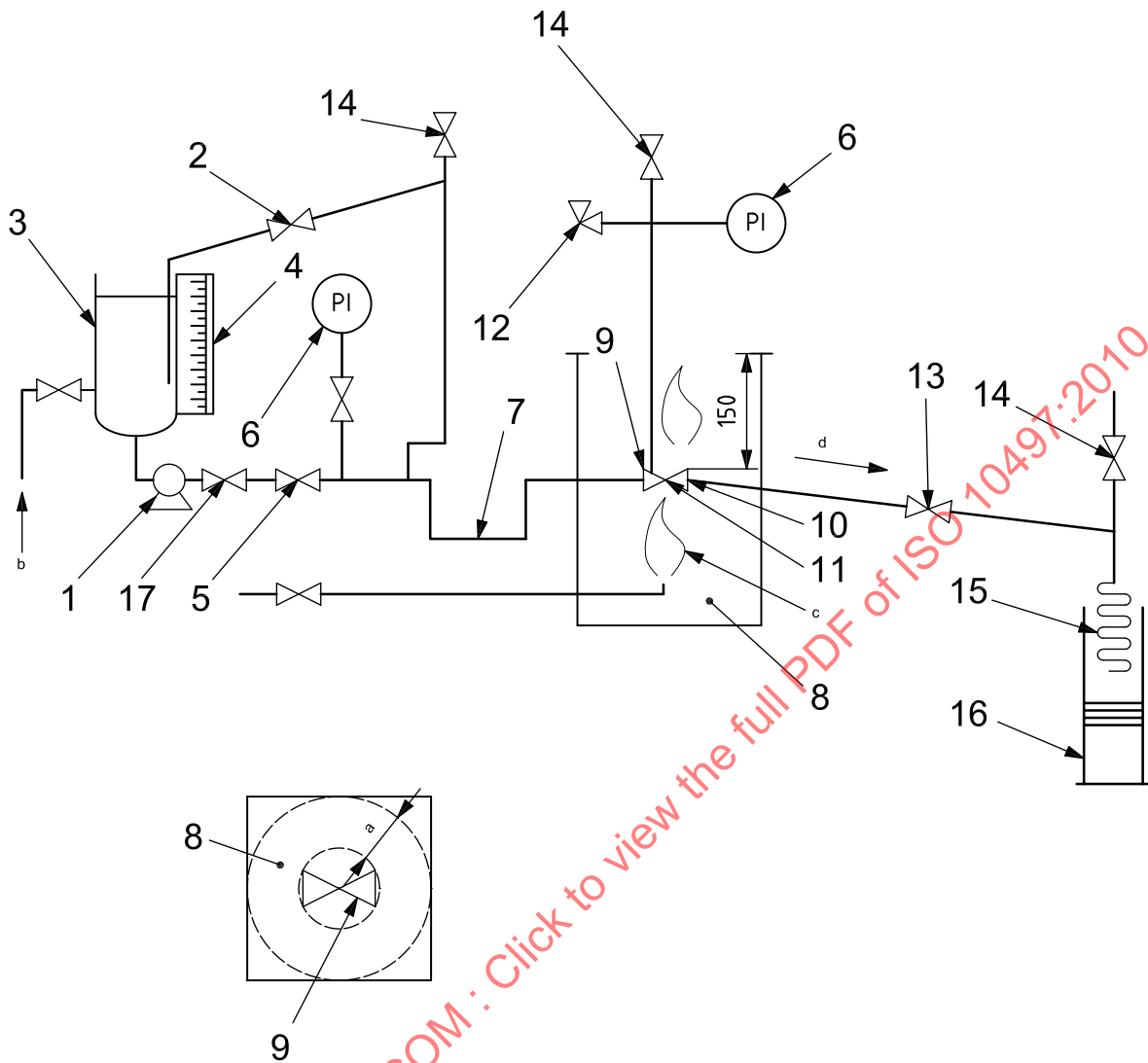
**5.6.6** Adjust the test system, excluding the test valve, during the test period to maintain the temperatures and pressures required.

**5.6.7** Open the fuel supply, establish a fire and monitor the flame environment temperature throughout the burn period of  $30^{+5}_0$  min. Check that the average temperature of the two flame environment thermocouples (11) reaches 750 °C within 2 min from the start of the burn period, i.e. from ignition of the burners. Maintain the average temperature between 750 °C and 1 000 °C, with no reading less than 700 °C for the remainder of the burn period of 30 min.

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1) 1 bar = 0,1 MPa =  $10^5$  Pa; 1 MPa = 1 N/mm<sup>2</sup>.

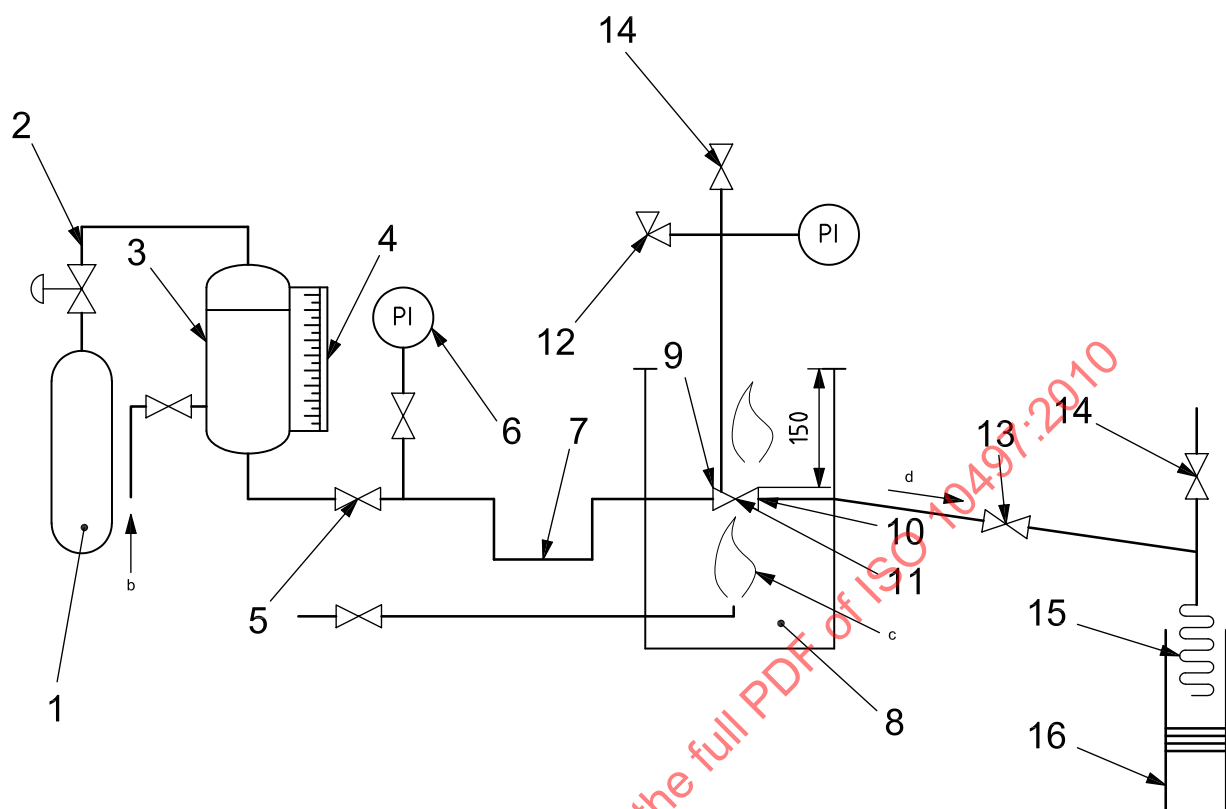
Dimensions in millimetres



a) Pump as pressure source

Figure 1 — Recommended systems (continued)

Dimensions in millimetres



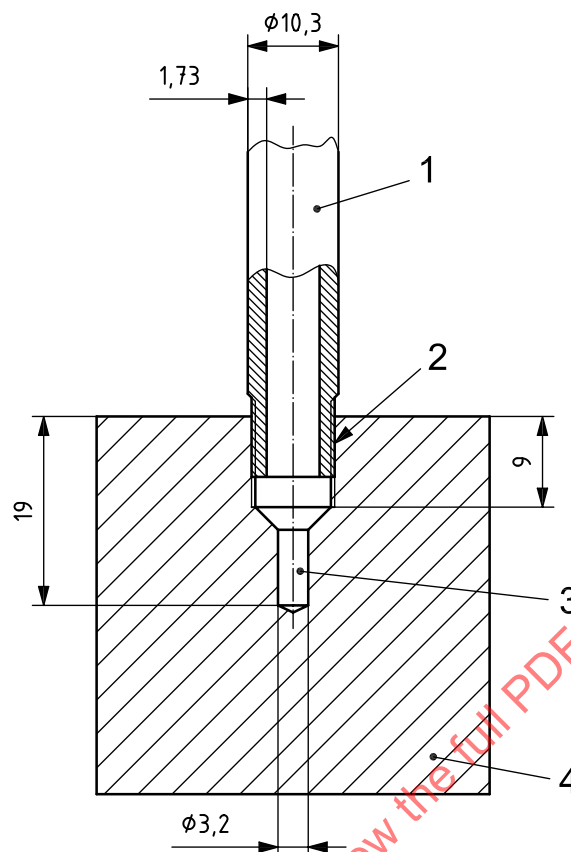
b) Compressed gas as pressure source

**Key**

- 1 pressure source
- 2 pressure regulator and relief
- 3 vessel for water
- 4 calibrated sight gauge
- 5 shut-off valve
- 6 pressure gauge
- 7 piping arranged to provide vapour trap (see 5.3.2)
- 8 enclosure for test
- 9 test valve mounted horizontally with stem in horizontal position (see 5.6.1)
- 10 calorimeter cubes (see 5.3.2)
- 11 flame environment and body thermocouples (see 5.3.2)
- 12 pressure gauge and relief valve (see 5.3.2)
- 13 shut-off valve
- 14 vent valve
- 15 condenser
- 16 container (see 5.3.2)
- 17 check valve

- a Clearance of 150 mm.
- b Water supply.
- c Fuel gas supply and burners.
- d Slope.

**Figure 1 — Recommended systems**

**Key**

- 1 pipe
- 2 pipe thread Rc 1/8 complying with ISO 7-1
- 3 thermocouple well
- 4 38 mm flame calorimeter cube

**Figure 2 — Calorimeter cube design and dimensions**

**5.6.8** The average temperature of the calorimeter cubes shall be 650 °C within 15 min of starting the burn period. For the remainder of the burn period, maintain the minimum average temperature of 650 °C, with no temperature falling to less than 560 °C. For valves subjected to the low-pressure test (see 5.6.1), the body thermocouple shall maintain 590 °C (1 100 °F) for at least 5 min and the bonnet thermocouple shall maintain 650 °C (1 200 °F) for at least 15 min of the burn period. The burn period may be extended by up to 5 min in order to achieve this requirement.

**5.6.9** Record instrument readings (6, 10, 11, 12) every 30 s during the burn period. Thermocouples should be numbered and individual records of temperature should be recorded.

**5.6.10** At the end of the burn period,  $30^{+5}_0$  min, shut off the fuel supply.

**5.6.11** Immediately determine the amount of water collected in the container (16) and establish the total through-seat leakage during the burn period. If the test valve is an upstream sealing type (see 5.6.3), deduct the volume of water trapped between the upstream seat seal and the downstream seat seal. Continue collecting water in the container (16) for use in establishing the external leakage rate of the test valve during the burn and cool-down periods.

**5.6.12** Within 5 min of extinguishing the fire, force-cool the test valve with water so that its external surface temperature remains below 100 °C; the time for cooling shall not exceed 10 min. Record the time taken to force-cool the external surface of the valve below 100 °C.

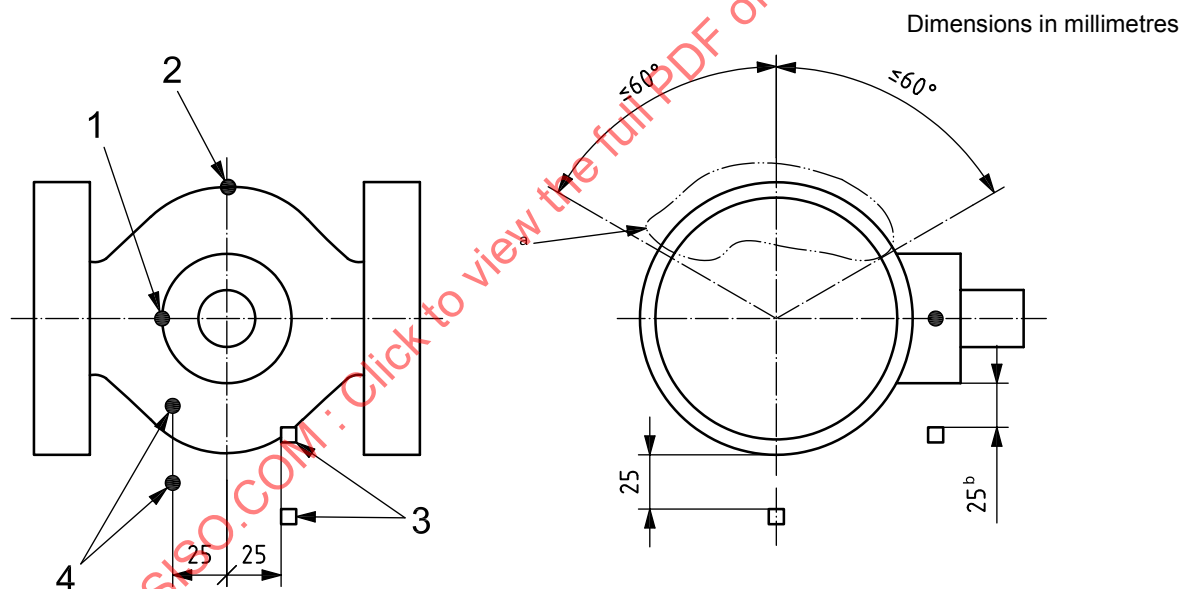
**WARNING** — The internal parts of the valve could remain at significantly higher temperatures than the external surface of the valve. Following the force cooling with water, additional time may be necessary to allow internals to cool to less than 100 °C.

**5.6.13** Check and adjust the test pressure in accordance with 5.6.4. Record the readings on the sight gauge (4) and determine the quantity of water in the container (16). Record any leakage through the external pressure relief device if fitted as part of the standard design. The figures are used to calculate the total external leakage throughout the burn and cool-down periods.

**5.6.14** For valves PN 100 or Class 600 and lower, decrease or stabilize the pressure to the low test pressure at 0,2 MPa (2 bar), and measure the through-seat leakage over a 5 min period.

**5.6.15** For all valves, increase or stabilize the test pressure to the high test pressure, then close the shut-off valve (13). Operate the test valve against the test pressure to the fully open position.

**5.6.16** Stabilize the pressure to the high test pressure and measure the external leakage over a 5 min period.



#### Key

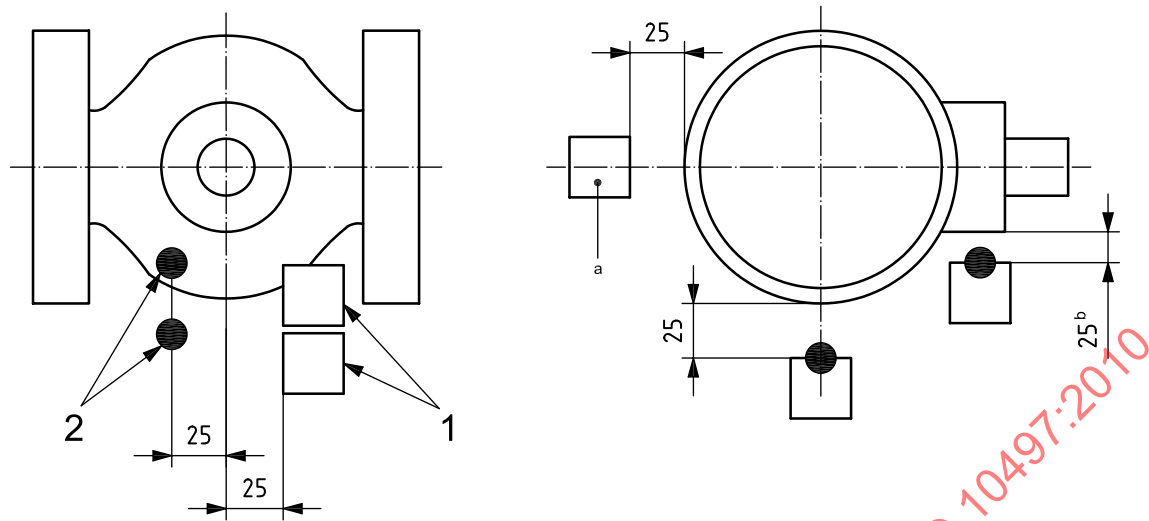
- 1 bonnet thermocouple
- 2 body thermocouple
- 3 38 mm flame calorimeter cubes
- 4 flame thermocouples

<sup>a</sup> The body thermocouple is installed in this area. When installed, the body and bonnet thermocouples are recessed into the valve body/bonnet a distance of 1/2 the thickness of the wall or 13 mm, whichever is the lesser.

<sup>b</sup> From the stem seal.

**Figure 3 — Location of temperature measurement sensors — Soft-seated valves up to DN 100 — NPS 4 — PN 10, PN 16, PN 25 and PN 40 — Class 150 and Class 300**

Dimensions in millimetres

**Key**

- 1 38 mm calorimeter cubes
- 2 flame thermocouples

a Additional calorimeter cube added for DN 200 (8 in) and above.

b From the stem seal.

NOTE These other valves include soft-seated valves larger than DN 100, NPS 4, PN 10, PN 16, PN 25 and PN 40, Class 150 and Class 300, and all valve sizes > PN 40, Class 300.

**Figure 4 — Location of temperature measurement sensors for all other valves**

## 6 Performance

### 6.1 General

Valves tested in accordance with Clause 5 shall be in accordance with 6.2 to 6.7.

### 6.2 Through-seat leakage during burn period

For the low-pressure test, the average through-seat leakage at low test pressure during the burn period (see 5.6.11) shall not exceed the value given in Table 1.

For the high-pressure test, the average through-seat leakage at high test pressure during the burn period (see 5.6.11) shall not exceed the value given in Table 1.

### 6.3 External leakage during burn and cool-down periods

For the low-pressure test, the average external leakage, not including through-seat leakage, during the burn and cool-down periods (see 5.6.13) shall not exceed the value given in Table 1.

For the high-pressure test, the average external leakage, not including through-seat leakage, during the burn and cool-down periods (see 5.6.13) shall not exceed the value given in Table 1.



## 6.4 Low-pressure test through-seat leakage after cool down

The maximum through-seat leakage shall not exceed the value given in Table 1.

## 6.5 Operability

After the fire test, the valve shall be unseated from the closed position against the high test pressure and moved to the fully open position (see 5.6.15) using the operator fitted to the test valve. Extension handles shall be allowed to protect the operator from risks associated with potential loss of containment during the valve operation provided that this does not result in an applied torque that is higher than that available from the fitted operator and the manufacturer's published torque value. Failure of the valve to operate at this torque means failure of the fire test.

## 6.6 External leakage following operational test

The average external leakage of the valve in the open position at the high test pressure (see 5.6.16) shall not exceed the value given in Table 1.

NOTE External leakage does not include potential leakage from the pipework-to-valve end connection (see 5.3.1).

**Table 1 — Maximum leak rates**

Maximum leak rates							
ml/min							
Valve size		Through-seat leakage			External leakage		
DN	NPS	During burn		After cool-down	During burn and cool-down		After operational test
		(see 5.6.11 and 6.2)		(see 5.6.14 and 6.4)	(see 5.6.13 and 6.3)		(see 5.6.16 and 6.6)
		Low test pressure	High test pressure	Low test pressure	Low test pressure	High test pressure	High test pressure
8	1/4	32	128	13	8	32	8
10	3/8	40	160	16	10	40	10
15	1/2	60	240	24	15	60	15
20	3/4	80	320	32	20	80	20
25	1	100	400	40	25	100	25
32	1 1/4	128	512	51	32	128	32
40	1 1/2	160	640	64	40	160	40
50	2	200	800	80	50	200	50
65	2 1/2	260	1 040	104	65	260	65
80	3	320	1 280	128	80	320	80
100	4	400	1 600	160	100	400	100
125	5	500	2 000	200	125	500	125
150	6	600	2 400	240	150	600	150
200	8	800	3 200	320	200	800	200
> 200	> 8	800	3 200	320	200	800	200

## 6.7 Test report

The test report shall include the following information:

- a) date of fire type-test;
- b) place at which the fire type-test was conducted;
- c) specification used for the fire type-test (including date of publication and applicable amendments);
- d) valve manufacturer's name and address;
- e) statement that the fire-tested valve has passed all the required hydrostatic, air type and production pressure tests required by the standard to which the valve was manufactured (manufacturer's statement may be accepted);
- f) full description of the valve tested, including nominal size, pressure rating designation, type (e.g. gate), weight, whether reduced or full bore, material of body/bonnet, trim material and manufacturer's reference number;
- g) markings on the valve and their locations, including manufacturer's nameplate date (if fitted);
- h) manufacturer's sectional drawing of the valve and a detailed parts list, including materials, of all valve components tested, identified in the text by identification number (drawing number) and revision and date of issue of documents;
- i) statement as to whether or not a gear box is fitted to the test valve and, if fitted, the type, manufacturer's name, model number and mechanical advantage;
- j) test pressure during burn and cool-down;
- k) time of test start, i.e. of ignition of burners;
- l) temperature recorded at start and at 30 s intervals throughout duration of test, with individual records for each thermocouple;
- m) through-seat leakage during burn period (see 6.2);
- n) external leakage during burn and cool-down periods (see 6.3);
- o) time required for valve to cool to 100 °C;
- p) through-seat leakage (low-pressure test) for valves PN 100 and Class 600 and lower;
- q) statement as to whether or not the test valve has been unseated and moved to the fully open position (see 6.5);
- r) external leakage in the open position (see 6.6);
- s) whether the valve is asymmetric and intended for bi-directional installation (test results in both directions);
- t) observations made during the course of the test that may have bearing on the results provided;
- u) declaration as to whether or not the test valve complied with the requirements of this International Standard;
- v) indication on the cover sheet or table of contents of the report of the total number of pages contained in the document (including drawings), with each page being numbered, e.g. 1/12, 2/12;
- w) name and affiliation of individuals witnessing the fire test;
- x) body cavity set relief pressure and setting.

## 7 Qualification of other valves by representative size, pressure rating and materials of construction

### 7.1 General

Instead of testing each nominal size and nominal pressure rating of a given valve design, all valves of the same basic design as the test valve may be deemed to have been fire-tested, subject to the following limitations.

- a) A test valve may be used to qualify valves larger than the test valve, but not exceeding twice the nominal size of the test valve (see 7.3). A size DN 200, NPS 8 or Nominal Size 9 test valve qualifies all larger sizes. If the minimum size of a given range of valves is greater than DN 200, NPS 8 or Nominal Size 9, then the minimum size of the range shall be tested to qualify all sizes.
- b) A DN 50, NPS 2 or Nominal Size 2 1/16 valve may be used to qualify all smaller sizes of valve of the same types. If the maximum size of a given range of valves is smaller than DN 50, NPS 2 or Nominal Size 2 1/16, then the maximum size of the range shall be tested to qualify all sizes.
- c) A test valve may be used to qualify valves with higher PN or Class ratings but not exceeding twice the PN or Class rating of the test valve, except as shown in 7.4.

A reduced bore (or Venturi pattern) test valve may be used to qualify a smaller nominal size full bore (or regular pattern) valve when the components associated with the obturator, seat seals and stem are identical in design and size. Leakage rates need to be those of the smaller full bore valve.

- d) The type of valve body ends are not considered by this International Standard. However, the mass of the valve is determined in part by the body end type. For qualification to the present International Standard, and providing that all other qualification criteria have been met, valves with ends different to those of the test valve may also qualify provided that
  - their mass is greater than that of the test valve, or
  - their mass is not less than 75 % of that of the test valve.

### 7.2 Materials of construction

**7.2.1** For the purposes of product compliance certification or type-testing systems, the materials of construction of the pressure retaining envelope of the valve shall be deemed to qualify other materials of construction within the generic classifications below.

- Ferritic
- Austenitic
- Duplex

**7.2.2** If a range of valves is covered by testing of ferritic test valves, then the type-testing coverage may be extended to cover austenitic or duplex materials by carrying out a further test on a mid-range size of valve of the same design in that material.

**7.2.3** Other materials of construction of the pressure-retaining envelope of the valve require full testing of representative size and pressure ratings as specified in 7.3 and 7.4. Nickel alloy valves may also be covered by austenitic stainless steel. Testing of low melting point alloys, e.g. aluminium bronze, shall be limited to valves rated PN 10, PN 16, PN 25 and PN 40, Class 150 and Class 300.

**7.2.4** Alloy steel bolting (e.g. B7, L7) used as part of the valve's pressure-retaining envelope may be used to qualify austenitic steel bolting but not vice-versa.