
**Transportable gas cylinders — Cylinder
valves — Specification and type testing**

*Bouteilles à gaz transportables — Robinets de bouteilles —
Spécifications et essais de type*

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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 10297 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*.

This second edition cancels and replaces the first edition (ISO 10297:1999), which has been technically revised.

Introduction

Cylinder valves are fitted on gas cylinders used in, for example, industrial, medical and breathing applications. Such valves have to perform safely and reliably for at least the cylinder test period, often in hazardous situations.

Valves complying with this International Standard can be expected to perform satisfactorily under normal services conditions.

This International Standard pays particular attention to:

- suitability of materials;
- dimensions of inlet connections;
- dimensions of outlet connections;
- safety (mechanical strength, endurance, resistance to ignition);
- leakage;
- cleanliness;
- testing;
- identification.

NOTE For satisfactory service, valves are manufactured and batch tested to ISO 14246.

Transportable gas cylinders — Cylinder valves — Specification and type testing

1 Scope

This International Standard specifies valve design, production and marking requirements, and type test methods for valves intended to be fitted to gas cylinders which convey compressed, liquefied or dissolved gases.

This International Standard does not apply to valves for cryogenic equipment, for fire extinguishers or for liquefied petroleum gas (LPG).

Additional specific requirements for valves fitted with pressure-reducing devices (see ISO 22435 and EN 738-3), residual pressure-retaining devices and non-return devices (see ISO 15996), and bursting discs and pressure-relief devices (see ISO 4126 and prEN 14513) are not covered by this International Standard.

NOTE Requirements for valves for liquefied petroleum gas (LPG) are specified in ISO 14245 and EN 13152, and in ISO 15995 and EN 13153. Requirements for valves for cryogenic vessels are specified in ISO 21011. Further specific requirements for valves for breathing apparatus are specified in EN 144-1, EN 144-2 and EN 144-3.

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 407, *Small medical gas cylinders — Pin-index yoke-type valve connections*

ISO 5145, *Cylinder valve outlets for gases and gas mixtures — Selection and dimensioning*

ISO 8573-1, *Compressed air — Part 1: Contaminants and purity classes*

ISO 10156, *Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*

ISO 10286, *Gas cylinders — Terminology*

ISO 10692-1, *Gas cylinders — Gas cylinder valve connections for use in the microelectronics industry — Part 1: Outlet connections*

ISO 15001, *Anaesthetic and respiratory equipment — Compatibility with oxygen*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions and symbols given in ISO 10286 and the following apply.

3.1 working pressure

p_w
 (compressed gases) settled pressure, at a uniform temperature of 15 °C, for a full gas cylinder with the maximum permissible charge of compressed gas

NOTE 1 In this International Standard, it corresponds to the maximum working pressure of the cylinders for which the valve is intended to be used.

NOTE 2 This definition does not apply to liquefied gases or dissolved gases (e.g. acetylene).

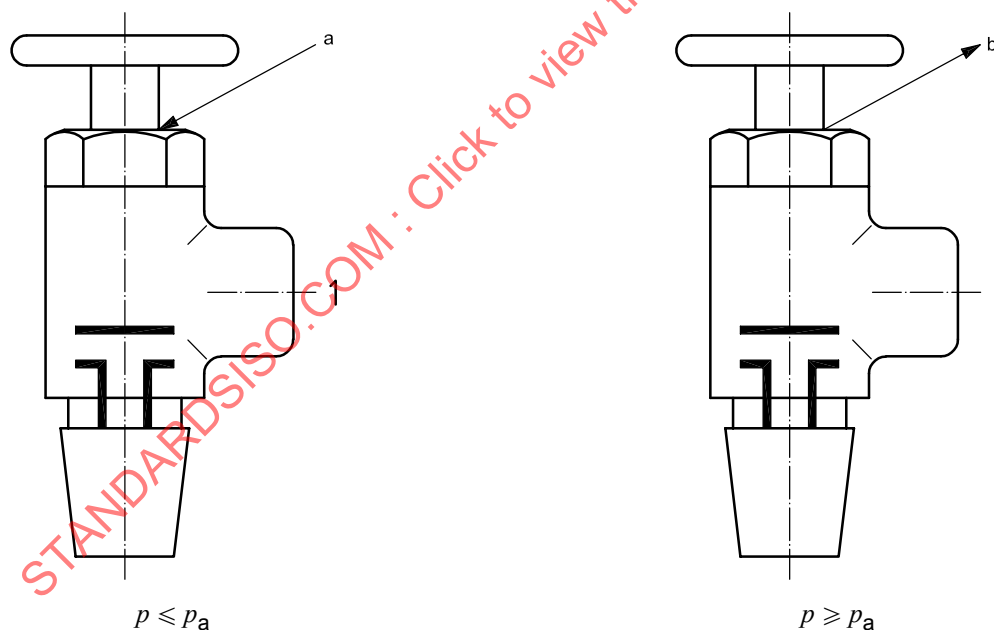
3.2 valve test pressure

p_{vt}
 pressure applied to a valve through a gas (or a liquid medium for hydraulic pressure test only) during type testing

3.3 external leak tightness

leak tightness to atmosphere (leakage in and/or leakage out) when the valve is open

NOTE See Figure 1.



Key

1 connection to customer equipment (closed)

a Leakage in.

b Leakage out.

p = internal pressure

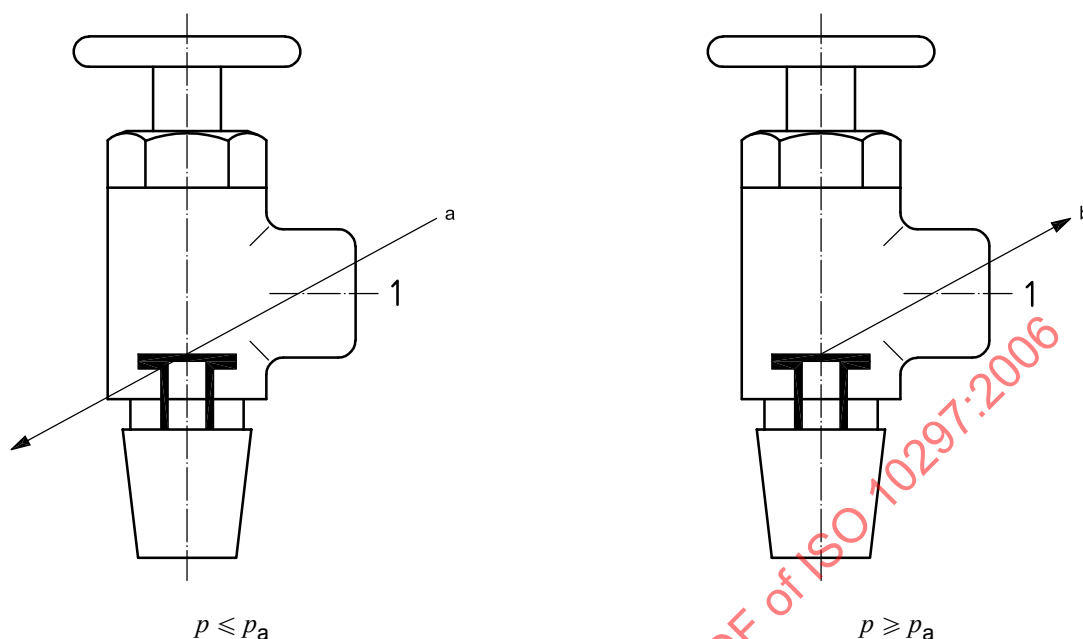
p_a = atmospheric pressure

Figure 1 — External leak tightness

3.4 internal leak tightness

leak tightness across the valve seat (leakage in and/or leakage out) when the valve is closed

NOTE See Figure 2.



Key

1 connection to customer equipment (open)

a Leakage in.

b Leakage out.

p = internal pressure

p_a = atmospheric pressure

Figure 2 — Internal leak tightness

3.5 minimum closing torque

T_c

torque necessary to be applied to a valve operating mechanism to obtain internal leak tightness

3.6 resistance torque

maximum opening or closing torque (whichever is the lesser) applied to a valve operating mechanism which the valve can withstand without damage

3.7 valve operating mechanism

mechanism which closes and opens the valve orifice

EXAMPLE A threaded valve spindle which, when rotated, raises and lowers a seal.

3.8 valve operating device

component which actuates the operating mechanism of the valve

EXAMPLE Handwheel or actuator.

3.9 total package mass

combined mass of a gas cylinder, its permanent attachment and its maximum allowed content

NOTE Valve and valve guard are examples of permanent attachments.

4 Valve design requirements

4.1 General

Valves shall operate satisfactorily over a range of service temperatures, from $-20\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$ in indoor and outdoor environments. The range may be extended for short periods (e.g. during filling). Where higher or lower service temperatures are required for longer periods, the purchaser shall specify accordingly. Valves shall be capable of withstanding the mechanical stresses or chemical attack they can experience during intended service, e.g. during storage, valving into cylinders, filling processes, transportation and end use of the cylinder.

4.2 Description

This International Standard does not prescribe the components that a cylinder valve shall comprise. A cylinder valve typically comprises the following:

- a) body;
- b) operating mechanism (to open and close the valve);
- c) valve operating device;
- d) means to ensure internal leak tightness;
- e) means to ensure external leak tightness;
- f) outlet connection(s) (to fill and discharge the cylinder);
- g) inlet connection to the cylinder;
- h) pressure-relief device (see ISO 11622 and/or other applicable standards, e.g. ISO 4126);
- i) siphon tube;
- j) screwed plug or cap on the outlet connection;
- k) excess flow limiting device;
- l) means to prevent the ingress of atmospheric air;
- m) residual pressure retaining device (see ISO 15996);
- n) outlet pressure reduction mechanism;
- o) flow restricting orifice;
- p) filter(s).

4.3 Materials

Metallic and non-metallic materials in contact with the gas shall be chemically and physically compatible with the gas, under all intended operating conditions (see, for example, ISO 11114-1, ISO 11114-2 and material specifications of the producer).

For medical and breathing applications, see ISO 15001, especially when selecting materials to reduce the risk of toxic products of combustion/decomposition from non-metallic materials including lubricants.

In medical or breathing applications, components which are in contact with the gas shall not be plated or coated unless means are provided to ensure that any particles generated by such surfaces are prevented from entering the gas stream.

Ignition resistance in oxygen or other highly oxidizing gases (see ISO 10156) of non-metallic materials and lubricants shall have been established by an appropriate test procedure (see ISO 11114-3).

Because of the risk of forming explosive acetylides, valves for acetylene may be manufactured from copper based alloys only if the copper content does not exceed 65 % (by mass). The manufacturer shall not use any procedure resulting in copper enrichment of the surface. For the same reasons, silver content of alloys, e.g. for brazing, shall be limited for acetylene valves. The acceptable limit shall be preferably 43 % (by mass), but in no case exceeding 50 %.

Non-metallic sealing materials for use with air, oxidizing (i.e. nitrous oxide) gases, oxygen and oxygen-enriched gases shall be capable of withstanding an ageing sensitivity test.

4.4 Dimensions

4.4.1 External dimensions

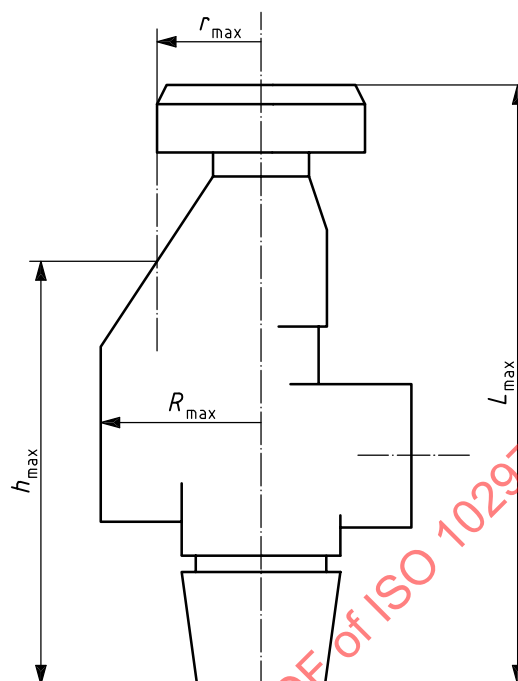
If the valve is intended to be protected by a cap complying with ISO 11117, the external dimensions shall comply with Figure 3. If the valve is of the 'pin-index yoke-type' for medical gases, the relevant external dimensions shall be in accordance with ISO 407.

4.4.2 Internal dimensions

The bore of the valve shall be adequate to meet the flow requirement (including that of any pressure-relief device fitted) without unacceptably reducing the strength of the stem connection.

4.5 Valve connections

Valves are normally connected to the cylinder by means of an inlet connection, e.g. taper thread in accordance with ISO 10920 for 25E or ISO 11116-1 for 17E, or parallel male thread in accordance with, for example, ISO 15245-1 for M30 or any relevant standard. They are connected to the filling and utilization appliances by means of one or more outlet connections complying with an accepted International Standard (e.g. ISO 407, ISO 5145, ISO 10692-1) or any relevant standard.

Key $r_{\max} = 32,5 \text{ mm}$ $R_{\max} = 38 \text{ mm}$ $h_{\max} = 90 \text{ mm}$ $L_{\max} = 125 \text{ mm}$ 

When the axes of the valve stem thread and handwheel do not coincide, the distance between the two axes shall be added to $r_{\max}$.

$R_{\max}$ shall be measured to the part of the valve furthest from the stem axis and includes any outlet plugs or caps if fitted.

NOTE 1 h represents the length of the lower part of the valve, when the maximum radius is greater than the radius of the handwheel.

NOTE 2 $L_{\max}$ is the maximum length of a valve in the closed position when not fitted to a cylinder.

Figure 3 — Maximum dimensions for cylinder valves protected by a cap in accordance with ISO 11117

4.6 Mechanical strength

4.6.1 Hydraulic pressure test

Cylinder valves shall be capable of withstanding for 2 min without permanent deformation, leak or rupture a hydraulic pressure test of 1,5 times the test pressure of the cylinder to which the valve is designed to be connected.

This pressure test shall be carried out at 450 bar for acetylene.

The hydraulic pressure test is given in 6.9.

4.6.2 Resistance to mechanical impact

For a valve used in a cylinder with water capacity greater than 5 l, and if the valve is not intended to be protected during transport by a cap or guard complying with ISO 11117, it shall withstand a mechanical impact with a minimum velocity of 3 m/s and an impact energy in joules equal to 3,6 times the total package mass (cylinder plus content) in kilograms or 40 J, whichever is the greater.

The impact test is given in Annex A.

4.7 Valve operating mechanism

The valve operating mechanism shall fulfil the following requirements.

- a) If it closes the valve by rotation this shall be in a clockwise direction.
- b) It shall be possible to open and close the valve at pressures up to the cylinder test pressure.
- c) It shall be designed in such a way that its setting cannot be inadvertently altered.
- d) It shall be designed to ensure that lubricants that are not oxygen-compatible (if used) do not come into contact with highly oxidizing gases, as defined in ISO 10156 (see also 4.3).
- e) For valves for highly oxidizing gases, as defined in ISO 10156, full opening of the valve orifice shall not result in an excessively rapid pressure surge.

NOTE This is normally achieved by a design which requires more than one turn to achieve full opening.

Compliance with a) to e) shall be checked by visual inspection.

- f) It shall function satisfactorily after 2 000 opening and closing cycles at p_{vt} without replacement of the sealing device.

The endurance test with relevant parameters is given in 6.12.

- g) For handwheel operated valves with handwheels of 65 mm diameter or more, or for valves operated by a key,
 - the torque required to close the valve and to meet the requirements of 4.8 shall be not greater than 7 N.m (a higher torque may apply for key operated valves) after completion of the endurance test;
 - the valve shall withstand a torque of 20 N.m without permanent deformation;
 - the closing torque, at failure, shall be not less than 25 N.m. At failure, no pressure retaining components shall have failed.

NOTE For valves with smaller handwheels, lower torque levels can apply (see 6.10 and 6.12).

- h) The operating torque, at failure, shall be less than the torque required to unscrew the operating mechanism from the valve body.

The excessive torque tests specified in g) and h) are given in 6.10.

- i) It shall be designed to permit the closure of the valve after exposure to a flame.

The flame impingement test is given in 6.13.

- j) For acetylene valves, it shall be designed to permit the closure of the valve after exposure to an acetylene flashback test.

The acetylene flashback test is given in 6.15.

4.8 Leakage

The internal leakage shall not exceed 6 cm³/h (at nominal conditions: 20 °C and 1013 mbar) over the range of pressures and temperatures (with a minimum of 0,1 bar for flammable and toxic gases or 0,5 bar in other cases) specified in the test, with the operating mechanism in the 'closed' position.

The external leakage shall not exceed 6 cm³/h over the range of pressures and temperatures specified in the test, with the operating mechanism in any position between and including the 'fully open' and the 'closed' positions.

The leak tightness tests are given in 6.11.

NOTE For pure or toxic gases, lower permitted leakage rates can be agreed upon between manufacturer and customer. For electronic applications, the permitted leakage rates are typically 1×10^{-7} He atm cm³/s.

The valve shall meet the requirements for leakage given above after 2000 opening and closing cycles at p_{vt} . The endurance tests are given in 6.12.

4.9 Resistance to ignition

All valves designed to be fitted to cylinders for oxygen and other gases with oxidizing potential greater than air (determined in accordance with ISO 10156) shall not ignite or show internal scorching damage when submitted to an oxygen pressure surge test.

The oxygen pressure surge test is given in 6.14.

5 Production requirements

5.1 Manufacturing

The valve body shall be manufactured by a process that will ensure the reproducibility of the mechanical characteristics necessary to meet the requirements specified in this International Standard. The anisotropy of the material shall be considered.

NOTE See ISO 14246.

5.2 Cleaning

Cylinder valves shall be supplied clean to meet the requirements of the intended service. Cylinder valves for all medical gases shall be supplied cleaned of oil, grease and particulate matter in accordance with ISO 15001.

6 Type test methods

6.1 General

Before valves are introduced into service, they shall be submitted for type testing. A type test is valid for a given family of valves with the same basic design.

Variations to connections do not require further type testing.

Changes to the basic dimensions of components or changes of material for reasons of compatibility of the material with gases (for example O-ring, packing, diaphragm, spindle, lubricant) constitute a type variant within the given family.

Type variants require repetition of the relevant parts of the type test.

Changes of the basic design dimensions of components or changes of the valve body material constitute a new family and require the full type test.

6.2 Documentation

The manufacturer shall make available, to the test body, the following documents.

- a) Set of drawings consisting of the general arrangement, parts list, material specifications and detail drawings. Any type variant, within the given family, shall be clearly identified.
- b) Description of valve and method of operation.
- c) Information on the intended use of the valve (gases and gas mixtures, pressures, use with or without valve protection device, etc.). It shall be clearly indicated which gases and gas mixtures can be used with each type variant.
- d) certificates of material compatibility as required.

6.3 Number of test samples

A minimum of nine sample valves is required (more samples can be necessary, depending on the number of type variants to be tested).

- a) One sample (No. 1) for the hydraulic pressure test.
- b) Samples for leak tightness tests and endurance test as follows:
 - 1) when no type variants are specified, five samples of the basic specification shall be tested (Nos. 2 to 6);
 - 2) when one type variant is specified, three samples (Nos. 2, 3 and 4) of the basic specification and two samples (Nos. 5a and 6a) of the type variant shall be tested.
 - 3) when two or more type variants (a, b, etc.) are specified, two samples (Nos. 2 and 3) of the basic specification and two samples of each type variant (Nos. 4a and 5a, 4b and 5b, etc.) shall be tested.
- c) One sample (No. 2) for the flame impingement test.
- d) One sample (No. 7) for any additional test required (e.g. impact test).
- e) Two samples (Nos. 8 and 9) for excessive torque tests.

The following additional test samples are required.

- a) For oxygen or highly oxidizing gas service: three sample valves (10 n, 11 n and 12 n) for the oxygen pressure surge test, and three further valves for every type variant.
- b) For acetylene service: three sample valves (10 m, 11 m, and 12 m) for the acetylene flashback test and the subsequent internal leak tightness test.

No valve used in prototype testing shall enter service.

6.4 Test report

A written report shall be prepared summarizing all tests carried out and the results obtained, and shall include the documentation listed in 6.2.

This report shall be signed by the responsible person(s) of the testing body.

The report shall be obtainable from the valve manufacturer on request.

6.5 Ambient conditions

Except where otherwise stated, carry out tests at room temperature.

6.6 Valve test pressure

For compressed gases:

$$p_{vt} = 1,2 \times p_w$$

For liquefied gases and dissolved gases under pressure (e.g. acetylene):

p_{vt} is at least equal to the minimum test pressure of the cylinder quoted in the relevant transportation regulation for that gas or gas group.

6.7 Test gas

Except where otherwise stated, carry out tests with clean, oil-free dry air or nitrogen. Air quality requirements with respect to oil shall be in accordance with ISO 8573-1 class 2 (oil content 0,1 mg/m³ and water content 0,117 g/m³ or a dew point of – 40 °C at atmospheric pressure).

6.8 Test sequence

Tests shall be carried out in accordance with the schedule given in Table 1.

See Annex B for an example test sequence for a basic design with type variants.

Table 1 — Sequence of tests (hydraulic pressure, excessive torque, leak tightness, endurance, oxygen pressure surge, flame impingement, visual examination and acetylene flashback) for type approval (no variants)

Test sequence	Test and relevant subclause	Condition of test valve	Test temperature °C	Valve sample number	Number of tests per valve	Total number of tests
1	Hydraulic pressure, 6.9	As received	Room temperature ^a	1	1	1
2	Excessive torque, 6.10	As received	Room temperature ^a	8 and 9	1	2
3	Internal/external leak tightness, 6.11	As received	Room temperature ^a	2 to 6 ^b	6 or 8 ^c	30 or 40 ^c
4	Internal/external leak tightness, 6.11	From test sequence 3, after aging at 65 °C for 5 days	Room temperature ^a	2 to 6 ^b	6 or 8 ^c	30 or 40 ^c
5	Endurance, 6.12	From test sequence 4	Room temperature ^a	2 to 6 ^b	1	5
6	Internal/external leak tightness, 6.11	From test sequence 5	Room temperature ^a	2 to 6 ^b	6 or 8 ^c	30 or 40 ^c
7	Internal/external leak tightness, 6.11	From test sequence 6	65 ± 2,5	2 to 6 ^b	6 or 8 ^c	30 or 40 ^c
8	Internal/external leak tightness, 6.11	From test sequence 7	– 20 ⁺⁰ _{–5}	2 to 6 ^b	6 or 8 ^c	30 or 40 ^c
9	Visual examination, 6.12	From test sequence 8	Room temperature ^a	2 to 6 ^b	1	5
10	Flame impingement, 6.13	From test sequence 9	800 to 1 000 (typical)	2	1	1
Only for O ₂ or oxidizing gases	Oxygen pressure surge 6.14	As received	See 6.14	10 n to 12 n	1	3
Only for C ₂ H ₂	Acetylene flashback, 6.15	As received	See 6.15	10 m to 12 m	1	3

^a Typically between 15 °C and 30 °C.

^b For additional type variants, valve sample numbers and tests will change in accordance with Annex B.

^c The total number of tests will be 30 without vacuum test and 40 if vacuum test is required.

6.9 Hydraulic pressure test

For safety reasons this test shall be carried out prior to all other tests.

The hydraulic pressure test shall be carried out under the following conditions:

- a) valve seat in open position;
- b) valve outlet connection sealed;
- c) safety relief devices (where fitted) removed and openings sealed;
- d) test medium of water or other suitable fluid;
- e) test pressure for compressed gases of $1,5 \times 1,5 p_w$;
- f) test pressure for liquefied gases of $1,5 p_{vt}$;
- g) test pressure for dissolved gases such as acetylene of 450 bar;
- h) pressure holding time of ≥ 2 min.

The pressure shall be raised continuously and gradually. The prototype valve shall withstand the test, without permanent deformation or rupture.

6.10 Excessive torque tests

The intent of these tests is to check that the valve operating mechanism has adequate strength, and fails safely if subjected to excessive torque.

These tests shall be carried out on the sample valves 8 and 9, at atmospheric pressure.

The closing torque on sample valve 8 shall gradually be increased to a given torque T (see below), at which the valve shall be able to work without noticeable difficulties and shall not show any significant damage. The torque shall then be increased slowly until failure of any part of the operating device occurs. The value of the torque at failure shall be not less than $1,25 \times T$.

This test shall then be repeated on sample valve 9, but with an opening torque instead of a closing torque.

After this test, the valve operating mechanism may be severely damaged and not operable. No pressure retaining components shall have failed. Disassembly of the mechanism is not permitted during this test.

For standard industrial gas cylinder valves, fitted with a handwheel of 65 mm diameter or more, $T = 20$ N-m.

This value of T will vary however with the design of valve and operating mechanism. It may be lower for small valves and higher for key operated valves.

The operating mechanism shall not be capable of withstanding a torque in excess of that required to disassemble the operating mechanism from the valve body (see 4.7).

6.11 Leak tightness tests

6.11.1 General

Each internal and external leak tightness test sequence shall comprise a sequence of tests at the four pressure settings given in Table 2.

The test pressure shall be held for not less than 1 min.

Table 2 — Test pressures for tightness tests

Test pressure sequence	Test pressure for tightness tests
1	Vacuum (e.g. 5×10^{-3} bar) if required
2	0,1 bar for toxic and flammable gases, 0,5 bar for all other gases
3	10 bar for all gases
4	p_{vt} (see 6.6)

6.11.2 Internal leakage

The internal leak tightness shall be determined in relation to the closing torque in accordance with the following procedure, on each of the five or more sample valves [see 6.3 b)].

- Blank off the valve outlet connection.
- Remove the pressure-relief device (where fitted) and seal the openings.
- Open the valve.
- Apply the specified pressure to the valve inlet.
- Close the valve to the desired torque. It is especially important that diaphragm valves are pressurized when the valve is being closed.
- Open the valve outlet connection.
- Wait at least 1 min before measuring the seat leakage rate.
- If the leakage rate is unacceptable (see 4.8), repeat the test sequence at a higher valve closing torque.

This test sequence shall be repeated for each test pressure given in Table 2.

6.11.3 External leakage

The external leak tightness shall be determined using the following procedure, on each of the five or more sample valves [see 6.3 b)].

- Blank off one opening (inlet or outlet) of the valve.
- Remove the pressure-relief device (where fitted) and seal the openings.
- Fully open the valve.
- Apply the specified pressure through the other opening.
- Measure the leakage rate.
- Partially close the valve.
- Measure the leakage rate.

If required, action f) and action g) may be repeated for different partial closings.

For test sequence 7 of Table 1, carried out at $(-20 \pm 5) ^\circ\text{C}$, the external leakage rate shall also be measured while the handwheel is being rotated.

6.12 Endurance test

An endurance test of 2 000 cycles, consisting in fully opening the valve, shall be carried out at p_{vt} (see Annex C).

After each closure, the pressure downstream of the seat shall be released to atmosphere. There shall be a pause of at least 6 s at each fully open and fully closed position.

Care should be taken to ensure that, during the test, friction does not cause the valve temperature to exceed significantly that specified in Table 1.

For valves with handwheels of 65 mm diameter or more, the closing torque used during the test shall be 7 N·m. No significant torque shall be applied in the fully open position.

For key operated or diaphragm valves which require a minimum closing torque (T_c) greater than 7 N·m, the torque used during the test shall be equal to $1,5 \times T_c$.

For valves with small handwheels (less than 65 mm), with a minimum closing torque of less than 7 N·m, the torque used during the test shall be at least twice the minimum closing torque but not less than $D \times (7/65)$, where D is the handwheel diameter expressed in millimetres, subject to a maximum of 7 N·m.

For all subsequent tests, the torque used during the endurance test shall not be exceeded.

For valves equipped with actuators, the test is to be conducted using the manufacturer's recommended parameters, e.g. actuation pressure, voltage supplies.

When the endurance test and the subsequent leak tightness tests have been completed, sealing elements such as diaphragms, bellows and O-rings shall be subjected to a visual check for any wear and/or damage, and the findings of such inspection shall be recorded.

6.13 Flame impingement test

The operating device of the sample valve (e.g. handwheel) shall be exposed for 1 min to an LPG blowpipe flame of 150 mm length, such that the flame reaches a typical temperature of between 800 °C and 1 000 °C. The operating device shall be completely enveloped by the flame.

Although the valve operating device may be damaged during the test, it shall still be possible to close the valve manually after cooling.

6.14 Oxygen pressure surge test

This test shall be carried out for valves used in all applications where the gas or gas mixture has an oxidizing potential greater than that of air (for the definition of oxidizing potential, see ISO 10156). For all types of valve, the pressure surge test shall be carried out with oxygen.

The purpose of the test is to check whether the valve withstands an oxygen pressure surge safely.

Three sample valves, samples 10 to 12, shall be tested in the 'as received' condition, or lubricated if a lubricant is used for such a valve.

Before the test, the ignition test installation shall be checked for the required pressure rise (for examples of test installation and pressure cycle specification, see Figures 4 and 5). For this purpose the test valve, at the end of the 1 m length of copper (or other oxygen resistant metallic material) tube, is replaced by a reliable pressure gauge.

The maximum pressure at the dead end of the tube (measured by pressure gauge and recorded on an oscilloscope) shall be achieved within $(20 \begin{smallmatrix} +0 \\ -5 \end{smallmatrix})$ ms (time necessary to reach p_{vt} starting from atmospheric pressure).

Stabilization time at p_{vt} is not fixed but shall be greater than or equal to 3 s. Before the next pressure surge the system (sample valve and tube) shall be depressurized down to atmospheric pressure. Stabilization time at atmospheric pressure is not fixed but shall be greater than or equal to 3 s.

The total time of the pressure cycle shall be 30 s, as illustrated in Figure 5. Total time is the time between the beginning of two consecutive pressure surges.

For calibration purposes, heated oxygen at (60 ± 3) °C shall be used.

The quality of oxygen shall be as follows:

- minimum purity 99,5 % by volume;
- hydrocarbon content $\leq 0,01$ % by volume.

Each test shall be carried out as follows.

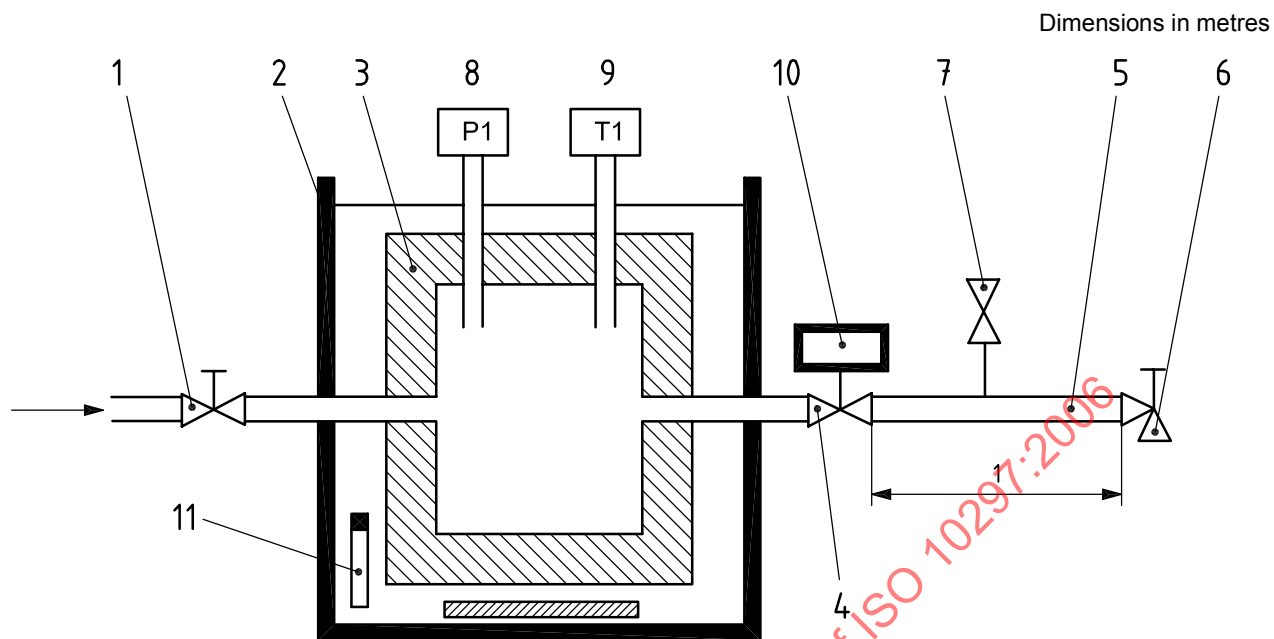
- a) Supply oxygen at a temperature of (60 ± 3) °C, directly into the connection of the valve to be tested, by means of a tube having an internal diameter of 5 mm and a length of 1 m. The specified material and dimensions of the tube are essential in order to ensure that a well-defined energy input into the valve to be tested is achieved.
- b) Perform two test sequences in accordance with Table 3. The test valve should be at room temperature at the start of each sequence.

Table 3 — Test sequence

Test sequence	Valve operating mechanism	Connection to the cylinder
1	Closed	Open
2	Open	Sealed with a screwed metallic plug

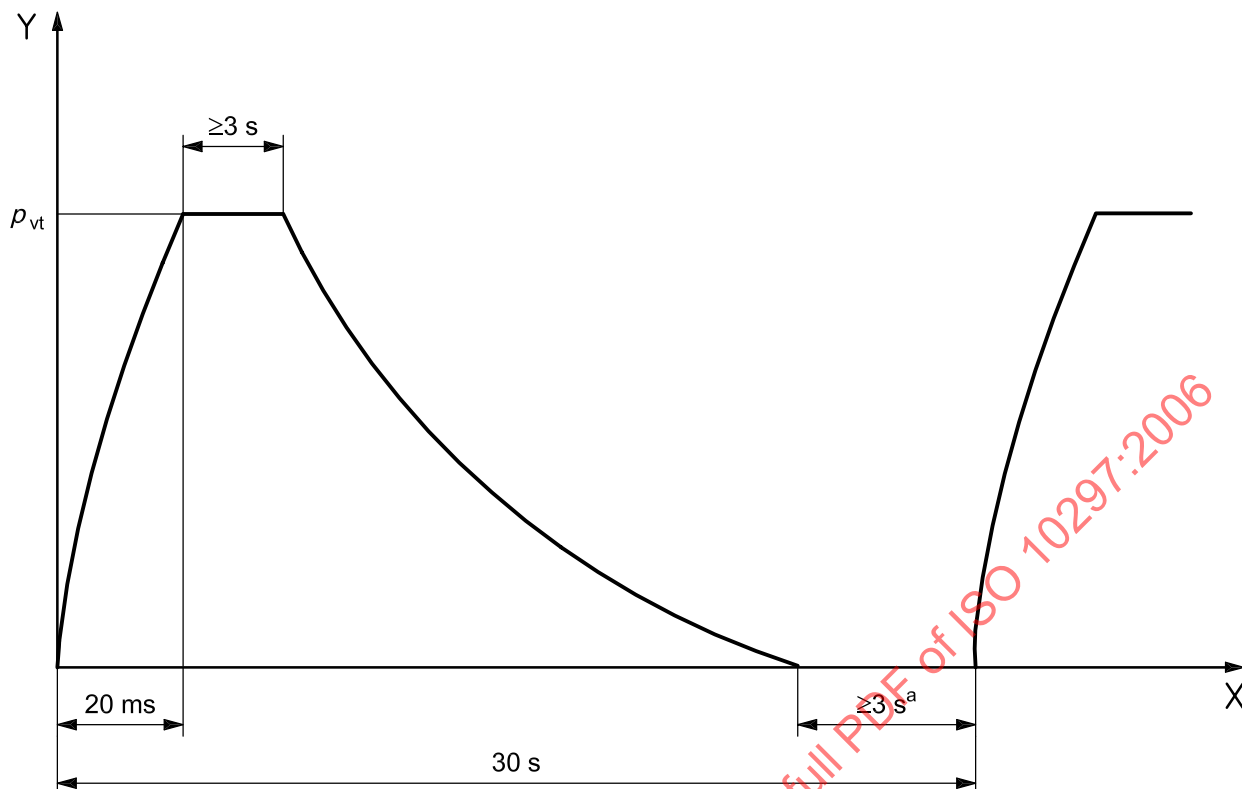
- c) The oxygen is heated to (60 ± 3) °C in the oxygen pre-heater. A quick opening valve (see Figure 4) controls the admittance of oxygen to the test sample valve. The test consists in subjecting the sample valve to 20 pressure cycles from atmospheric to the valve test pressure (p_{vt}) (see Figure 5).

After the tests, the sample valve shall be dismantled and carefully checked, including close examination of non-metallic components. It shall not show any traces of ignition.

**Key**

- 1 inlet valve
- 2 pre-heating device (e.g. water bath with electric heating)
- 3 oxygen high-pressure vessel
- 4 quick opening valve
- 5 tube
- 6 sample valve
- 7 depressurization valve
- 8 pressure gauge
- 9 temperature gauge
- 10 actuator
- 11 thermostat

Figure 4 — Example of an oxygen pressure surge test installation

**Key**

- X time
 Y pressure
 a Pause.

Figure 5 — Pressure cycle specification

6.15 Acetylene flashback test

This test is for valves intended for acetylene service.

The purpose of the test is to establish whether the sample valve is able to withstand an acetylene flashback. After the flashback test, it shall be possible to close the valve.

Where the sample valve is fitted with an integral pressure-relief device, this device shall be closed for the test.

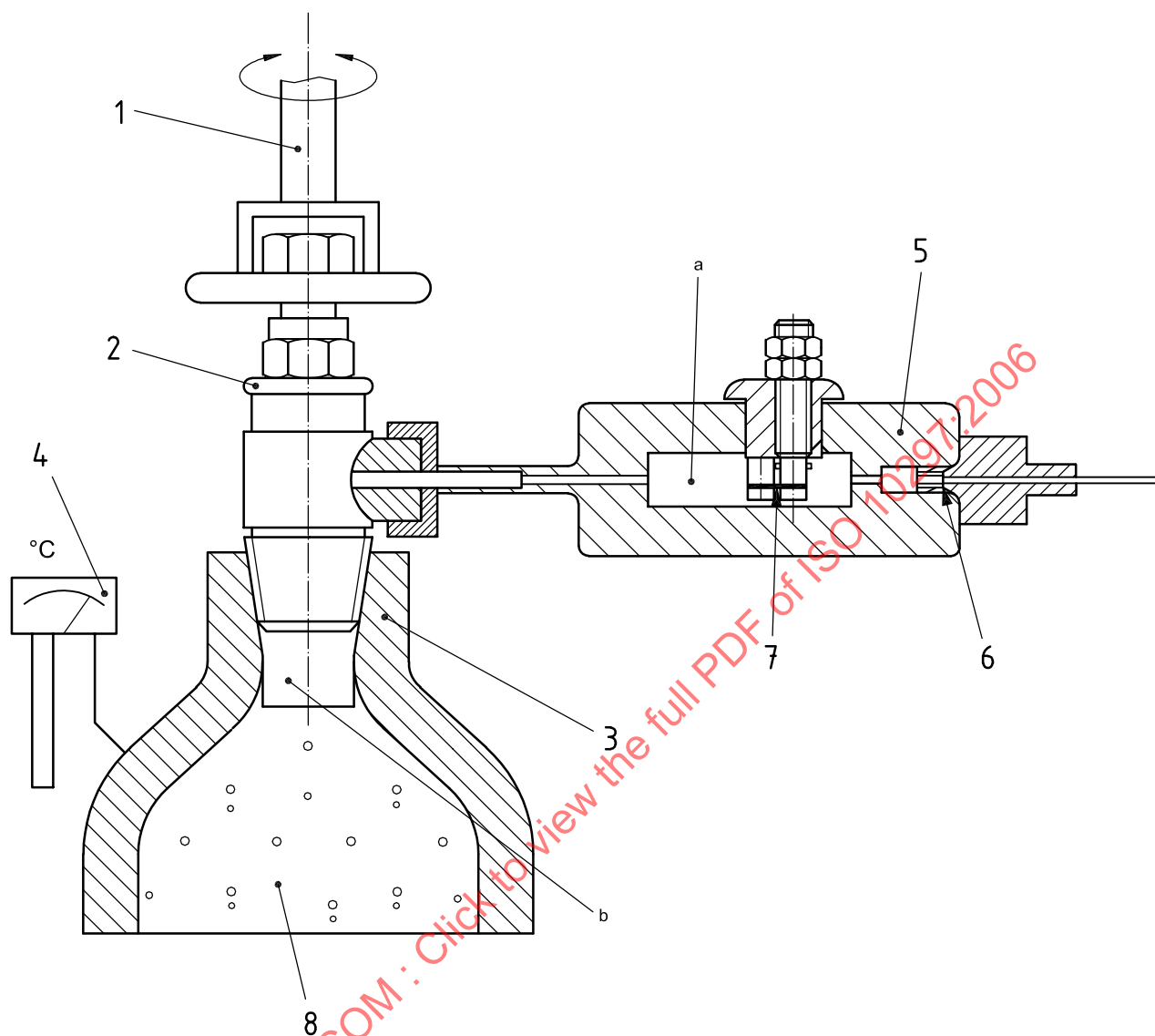
The acetylene cylinder used for the test shall have a free volume at the top of the cylinder of approximately 150 cm³.

The sample valve shall be screwed into an acetylene cylinder of 5 l water capacity (prepared with porous mass and solvent). No neck filter shall be fitted to the cylinder or the valve.

The cylinder shall be filled with at least half of its maximum permissible quantity of acetylene. An igniter tube of volume 30 cm³ is connected to the outlet boss (see Figure 6). This igniter tube is closed at one end by a bursting disc having a maximum burst pressure of 40 bar. The decomposition of the acetylene propagates into the cylinder causing, due to a pressure rise, the rupture of the bursting disc and the flow of hot decomposition gases out of the valve.

After 30 s the sample valve shall be closed, from a safe distance (i.e. by remote operation).

The cylinder shall be left until stable (approximately 24 h). The internal tightness of the valve shall then be checked, and the leakage rate shall not exceed 50 cm³/h.

**Key**

- 1 remotely operated closing device
- 2 sample valve
- 3 acetylene cylinder
- 4 temperature indicator

- 5 igniter tube
- 6 bursting disc
- 7 constantan wire
- 8 porous mass

a Approximate volume 30 cm³.

b Approximate volume 150 cm³.

Figure 6 — Example of acetylene flashback test apparatus

7 Marking

Cylinder valves shall be durably and legibly marked with the following:

- a) coded number of this International Standard "ISO V";
- b) manufacturer's identification;
- c) year and month (or week) of manufacture, e.g. YY/MM or YY-WW;
- d) identification of the valve inlet connection;
- e) identification of the valve outlet connection if it is not already required by the relevant outlet connection.

For valves meeting the requirement of 4.6.2, the maximum permitted total package mass for which the valve has been tested shall be marked (e.g. 70 kg).

Additional marking can be required for valves used in medical and breathing applications or upon request.

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Annex A (normative)

Valve impact test

In circumstances where cylinder valves are used in cylinders of water capacity greater than 5 l and where valve protection is not intended to be fitted during transportation, the following test shall be carried out. The purpose of this test is to ensure that the valve has sufficient inherent strength to withstand impacts that may occur during transport.

One valve, in the closed conditions (closed to the torque used in the endurance test, in accordance with 4.7), shall be fitted into a gas cylinder neck equipped with the corresponding screw thread, or a similar fixture (see Figure A.1), to a torque as used in service (see ISO 13341). The valve shall protrude from the cylinder neck, or fixture, by the same nominal amount as in service.

The valve shall be struck by a plummet weight tipped with a 13 mm diameter hardened steel ball, which has a minimum velocity of 3 m/s and results in an impact energy (in joules) equal to 3,6 times the total package mass (cylinder plus content) in kilograms or 40 J, whichever is the greater.

EXAMPLE A package mass of 100 kg requires an impact test at 360 J.

The impact shall be at 90° to the longitudinal axis of the valve and co-incident with a plane passing through the same axis.

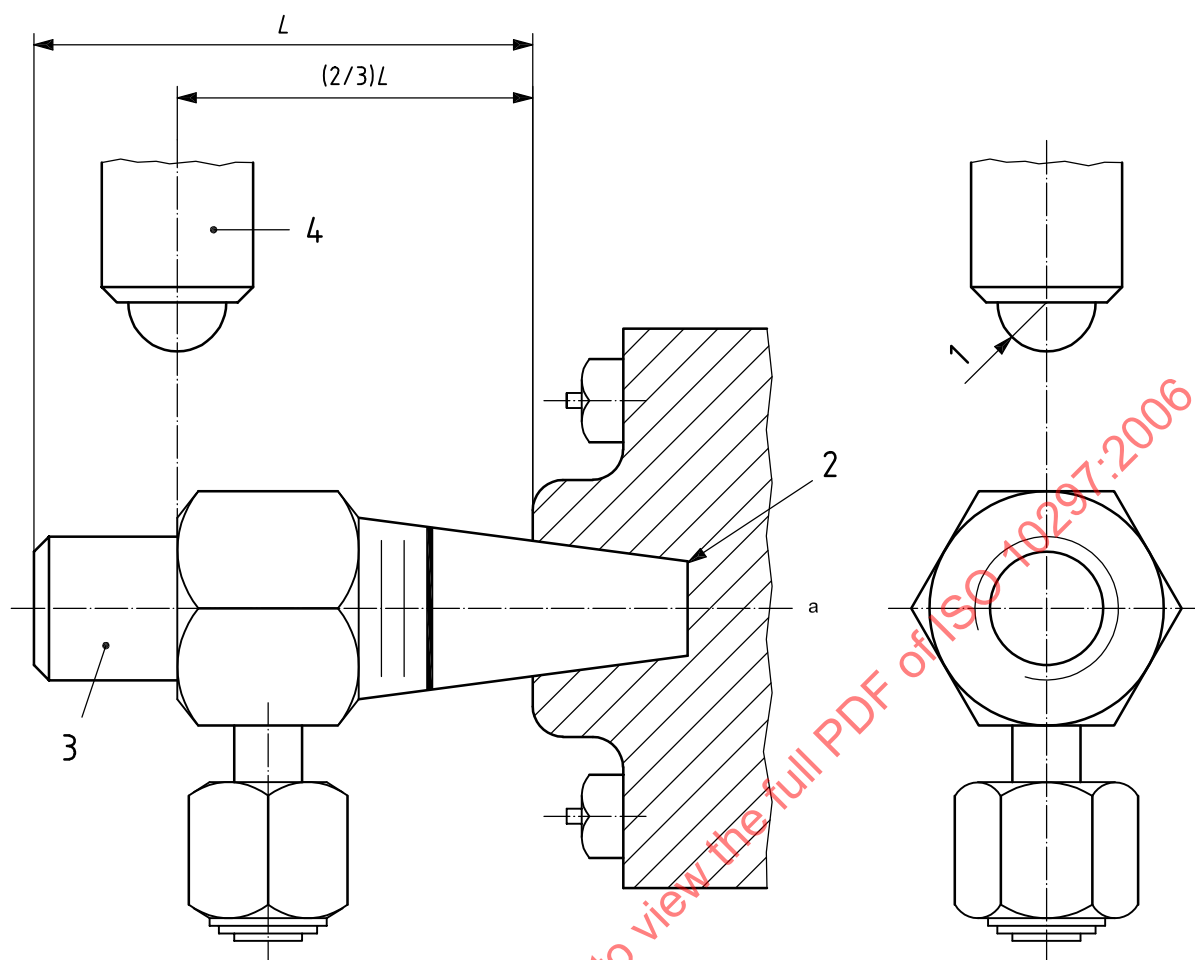
The point of impact shall be two-thirds of the distance L from the plane where the valve stem thread meets the cylinder to the furthest point of the valve body, measured along the longitudinal axis of the valve (see Figure A.1).

The point of impact on the valve shall not be obstructed by features such as outlet connecting threads, pressure-relief devices, handwheel, etc.

The valve shall be struck once only, and shall withstand the appropriate impact energy given in 4.6.2. Distortion due to impact is permissible.

After testing, the valve shall be removed from the test rig, fitted into a pressure supply and closed to the torque used in the endurance test, in accordance with 4.7.

Valve test pressure (p_{vt}) shall be applied to the valve inlet. The leakage shall conform to 4.8.



Key

- 1 hardened steel ball, diameter 13 mm
- 2 fixture or cylinder
- 3 valve
- 4 plummet weight
- a Longitudinal axis.

Figure A.1 — Impact test

Annex B (informative)

Example of test sequence

Table A.1 gives an example test sequence for one design of test valve, with different O-ring material specifications and three different outlet specifications.

The O-ring specifications are as follows:

- a) O₂ service – fluorocarbon (FKM);
- b) C₂H₂ service – ethylene propylene (EPDM);
- c) N₂ service – nitrile rubber (NBR).

Table B.1 — Sequence of tests for type approval (basic design plus two type variants)

Basic design O ₂ service		Type variant C ₂ H ₂ service different outlet connection		Type variant N ₂ service different outlet connection	
Test sequence	Sample valve number	Test sequence	Sample valve number	Test sequence	Sample valve number
1	1	—	—	—	—
2	8 and 9	—	—	—	—
3	2 and 3	3	4a and 5a	3	4b and 5b
4	2 and 3	4	4a and 5a	4	4b and 5b
5	2 and 3	5	4a and 5a	5	4b and 5b
6	2 and 3	6	4a and 5a	6	4b and 5b
7	2 and 3	7	4a and 5a	7	4b and 5b
8	2 and 3	8	4a and 5a	8	4b and 5b
9	2 and 3	9	4a and 5a	9	4b and 5b
10	2	—	—	—	—
Plus oxygen pressure surge test	10 n, 11 n and 12 n	Plus acetylene flashback test	10 m, 11 m and 12 m	—	—