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Gas cylinders — Self-closing cylinder valves — Specification and type testing

Bouteilles à gaz — Robinets de bouteilles équipés de clapets auto-obturants — 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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

Introduction

This document covers the function of a self-closing cylinder valve as a closure (defined by the UN Model Regulations). Additional features of self-closing cylinder valves (e.g. pressure relief devices) might be covered by other standards and/or regulations.

Self-closing cylinder valves conforming to this document can be expected to perform satisfactorily under normal service conditions.

This document pays particular attention to:

a) suitability of materials;

b) safety (mechanical strength, impact strength, endurance, leak tightness, resistance to ignition, resistance to acetylene flashback);

c) testing;

d) marking;

e) manufacturing tests and examinations.

In this document, the unit bar is used due to its universal use in the field of technical gases. It should, however, be noted that bar is not an SI unit, and that the corresponding SI unit for pressure is Pa (1 bar = 10^5 Pa = 10^5 N/m^2).

Pressure values in this document are given as gauge pressure (pressure exceeding atmospheric pressure) unless noted otherwise.

Gas cylinders — Self-closing cylinder valves — Specification and type testing

1 Scope

This document specifies the design, type testing, marking and manufacturing tests and examinations requirements for self-closing cylinder valves intended to be fitted to refillable transportable gas cylinders which convey compressed, liquefied or dissolved gases.

NOTE 1 The main applications for such self-closing cylinder valves are in the calibration gas and beverage industries.

This document covers the function of a self-closing cylinder valve as a closure.

NOTE 2 Requirements for standard cylinder valves are given in ISO 10297. Requirements for quick-release cylinder valves are given in ISO 17871.

This document is not applicable to self-closing cylinder valves for cryogenic equipment, for portable fire extinguishers, or for liquefied petroleum gas (LPG).

NOTE 3 Requirements for valves for cryogenic vessels are specified in ISO 21011 and at a regional level, for example, in EN 1626. Requirements for valves for portable fire extinguishers at a regional level are specified, for example, in EN 3 series. Requirements for self-closing LPG cylinder valves are specified in ISO 14245.

NOTE 4 Additional requirements for pressure-relief devices might be specified in international/regional regulations/standards.

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 10286, *Gas cylinders — Terminology*

ISO 10297:2014, *Gas cylinders — Cylinder valves — Specification and type testing*

ISO 10524-3, *Pressure regulators for use with medical gases — Part 3: Pressure regulators integrated with cylinder valves*

ISO 11114-1, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

ISO 11114-2, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

ISO 13341, *Gas cylinders — Fitting of valves to gas cylinders*

ISO 14246, *Gas cylinders — Cylinder valves — Manufacturing tests and examinations*

ISO 22435, *Gas cylinders — Cylinder valves with integrated pressure regulators — Specification and type testing*

3 Terms and definitions

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

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

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

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

3.1
self-closing cylinder valve
cylinder valve with a normally closed *valve operating mechanism* (3.2) that is actuated by a separate *operating device* (3.3) which is not an integral part of the cylinder valve

3.2
valve operating mechanism
mechanism which opens the valve orifice by an *operating device* (3.3) and closes automatically when or before the operating device is disconnected and which includes the internal sealing system

3.3
operating device
external component which actuates the *valve operating mechanism* (3.2)

EXAMPLE Push-pin as part of a regulator, lever-operated push-pin.

3.4
external leak tightness
leak tightness to atmosphere when the valve is open

Note 1 to entry: Some designs of self-closing valves cannot leak externally except through the outlet connection.

3.5
internal leak tightness
leak tightness to atmosphere when the valve is closed and pressurized from the inlet

3.6
valve working pressure
p_w
settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full gas cylinder for which the valve is intended

Note 1 to entry: This definition does not apply to liquefied gases (e.g. carbon dioxide) or dissolved gases (e.g. acetylene).

Note 2 to entry: The valve working pressure is expressed in bar.

3.7
valve burst test pressure
p_{vbt}
minimum pressure applied to a valve during hydraulic burst pressure test

Note 1 to entry: The valve burst test pressure is expressed in bar.

3.8
valve test pressure
p_{vt}
minimum pressure applied to a valve during testing

Note 1 to entry: The valve test pressure is expressed in bar.

3.9
total package mass
combined mass of a gas cylinder, its valve(s), its permanent attachment(s) and its maximum allowed gas content

Note 1 to entry: Valve guards but not valve protection caps are examples of permanent attachments.

Note 2 to entry: The total package mass is expressed in kg.

3.10
valve inlet connection
connection on the valve which connects the valve to the cylinder

3.11
valve outlet connection
connection on the valve used to discharge the cylinder

Note 1 to entry: For most valves, this connection is also used for filling the cylinder.

3.12
valve filling connection
connection on the valve used to fill the cylinder

Note 1 to entry: For some valves, the valve filling connection is different from the valve outlet connection.

3.13
normal temperature and pressure
NTP
temperature of 20,0 °C (293,15 K) and pressure of 1,013 bar absolute (0,101 3 MPa absolute)

4 Valve description

4.1 A self-closing valve typically comprises a:

a) valve body;

b) valve operating mechanism;

c) valve outlet connection(s);

d) valve inlet connection.

4.2 Valves can also include:

a) a pressure-relief device;

NOTE Some transport regulations require or forbid pressure relief devices for some gases, gas mixtures or gas groups.

b) a dip tube;

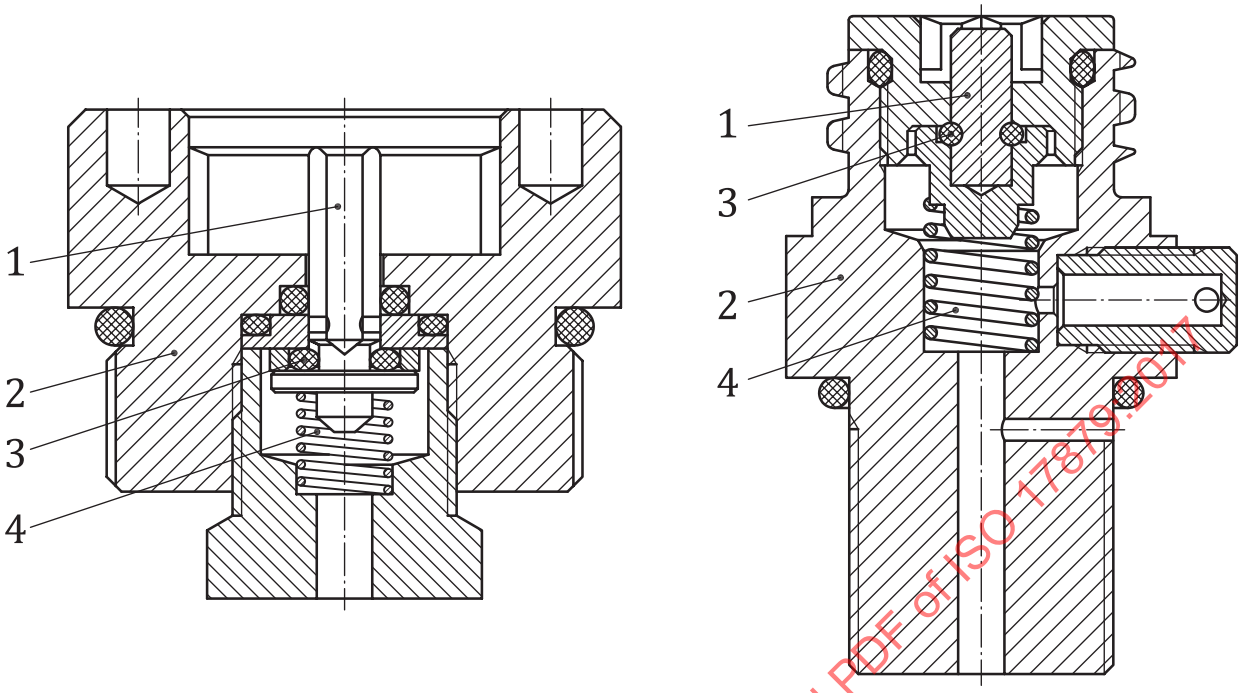
c) an outlet connection plug/cap;

d) an excess flow device;

e) a flow restricting orifice;

f) a filter(s).

4.3 Typical designs are given in Figure 1.



Key
1 poppet
2 valve body
3 seat insert/soft seal
4 seat closing spring

Figure 1 — Typical self-closing cylinder valve designs

5 Valve design requirements

5.1 General

Valves shall operate within specification and be leak tight over a range of service temperatures, from at least −20 °C to +65 °C in indoor and outdoor environments.

Closed valves shall be internally leak tight during transport and storage (see test 4 in Table 2) for temperatures down to −40 °C.

Where higher or lower service temperatures are required, any additional requirements and tests shall be agreed between the manufacturer and purchaser.

5.2 Materials

Metallic and non-metallic materials in contact with the gas shall be chemically and physically compatible with the gas, in accordance with ISO 11114-1 and ISO 11114-2, under all intended operating conditions. For valves used for dissolved gases, the compatibility of the materials in contact with the solvent shall also be considered. For valves used with gas mixtures, the compatibility of the gas wetted materials with each component of the gas mixture shall be considered.

Copper alloys in contact with oxygen or other oxidizing gases or gas mixtures shall have a maximum aluminium content of no more than 2,5 %.

When using plated or coated components in gas wetted areas, the material compatibility of both the plating/coating material and the substrate material shall be taken into account. In addition, consideration should be given to avoid flaking or particle generation, especially for oxygen, other oxidizing gases (as defined in ISO 10156) and gas mixtures containing oxygen or other oxidizing gases.

The material used for the valve body shall be of either:

a) a material not showing a ductile to brittle transition (e.g. copper alloys, austenitic stainless steels, aluminium alloys and nickel alloys), or;

b) a ferritic material (e.g. carbon steel) having an impact value greater than 27 J at −40 °C when submitted to the Charpy pendulum impact test as specified in ISO 148-1.

The ignition resistance of non-metallic materials, lubricants and adhesives used in the gas wetted area of valves requiring oxygen pressure surge testing (see 5.7) should be considered (e.g. using an appropriate test procedure such as ISO 11114-3 for auto ignition temperature (AIT) testing and ISO 21010:2014, Annex C for oxygen pressure surge testing of materials). Non-metallic materials used in oxygen wetted areas should have an AIT of at least 100 °C above the maximum service temperature of the valve, tested at a pressure of at least 100 bar (see ISO 15001 or ASTM G63).

Lubricants used in the gas wetted area of valves for gases requiring oxygen pressure surge testing (see 5.7) shall either:

1) be rated for:

   — at least p_{vt} in cases of single gases, or;

   — a pressure not less than the corresponding oxygen partial pressure in case of gas mixtures containing other oxidizing gases than air with a partial pressure greater than 30 bar, or;

   NOTE This rated pressure is the maximum pressure at which the lubricant passed the oxygen pressure surge test described in ISO 21010:2014, Annex C.

2) be permitted only if the corresponding valve passes the oxygen pressure surge test after being pre-conditioned via the endurance cycling procedure but without subsequent leak tightness tests and final visual examination being performed.

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

5.3 Valve connections

Valve inlet and outlet connections shall conform to the requirements of an International Standard, other regional or national standards or proprietary designs that have been qualified to an acceptable industry standard.

NOTE 1 International valve inlet connection standards are, for example, ISO 11363-1 and ISO 15245-1.

NOTE 2 International valve outlet connection standards are, for example, ISO 5145 and ISO 10692-1. A partial compilation of regional and national standards is given in ISO/TR 7470.

NOTE 3 Qualification procedures for proprietary valve inlet connection designs are, for example, given in ISO 10692-2.

NOTE 4 Qualification procedures for proprietary valve outlet connection designs are, for example, given in CGA V-1.

If the valve filling connection is separate to the valve outlet connection and not equipped with a non-return valve or isolating valve, it shall be provided with a pressure-tight device (e.g. a plug or cap which can be operated or removed only by the use of a special tool). Where applicable, such a pressure-tight device shall be designed to vent gas before becoming disengaged.

The valve filling connection non-return valve, if fitted, shall conform to the relevant requirements of ISO 22435 for industrial applications or ISO 10524-3 for medical applications.

NOTE 5 See ISO 5145 for examples of valve filling connections.

5.4 Mechanical strength

5.4.1 Resistance to hydraulic burst pressure

Valves shall withstand p_{vbt} (see 6.6.1) without permanent visible deformation or burst.

The hydraulic burst pressure test is specified in 6.9.

5.4.2 Resistance to mechanical damage

To ensure mechanical integrity, valves shall withstand an impact test according to A.1, except if permanently protected. If the dimensions of a valve make this test impracticable, then the drop test according to A.2 shall be carried out.

The valve shall not break off from the cylinder. Distortion due to impact/drop is permissible. The valve shall be leak tight as specified in A.1 or A.2.

In addition, the test sample shall remain capable of being opened for emergency venting purposes by using a simple tool (e.g. a pin) or the corresponding valve operating device.

5.5 Valve operating mechanism

5.5.1 The valve operating mechanism shall meet the requirements of 5.5.2 and 5.5.3.

5.5.2 It shall be possible to open and close the valve at pressures up to p_{vt} (see 6.6.2) using equipment recommended by the manufacturer. This shall be verified during endurance test (see 6.11).

It should be designed in such a way that the setting of the operating position of the valve cannot be inadvertently altered, i.e. if the valve is closed, it should remain closed during normal service or normal transport.

5.5.3 The valve operating mechanism shall function satisfactorily after 2 000 opening and closing cycles at p_{vt} (see 6.6.2) without replacement of the sealing system.

The endurance test is specified in 6.11.

After the endurance test and the subsequent leak tightness tests have been performed, a visual examination shall be carried out to ensure that no components are displaced (no longer in the place where it was installed), non-functional (e.g. broken) or missing.

The visual examination is specified in 6.12.

5.5.4 Valves for gases requiring oxygen pressure surge testing (see 5.7) should have a slow opening characteristic curve to avoid rapid pressure surge. This can be achieved using flow limiting devices.

5.6 Leakage

The internal leakage shall not exceed 6 cm^3/h (except for valves for acetylene, see Annex B), corrected to NTP over the range of pressures and temperatures specified in Table 2 and Table 3, with the valve operating mechanism in the closed position.

NOTE The leakage of 6 cm^3/h is approximately 4 bubbles of 3,5 mm diameter per minute.

The total external leakage [typically comprising that from the valve external sealing system, if existent (see 3.4), plus e.g. pressure relief device, pressure indicating devices] shall not exceed 6 cm^3/h, corrected to NTP over the range of pressures and temperatures specified in Table 2 and Table 3, with the valve operating mechanism in the open position.

For pure or toxic gases, lower permitted leakage rates may be agreed upon between the manufacturer and customer. For electronic applications, the permitted leakage rates are typically 1×10^{-7} He atm cm^3/s.

The leak tightness tests are specified in 6.10.

5.7 Resistance to ignition

To verify resistance to ignition, an oxygen pressure surge test shall be carried out on valves used for:

a) oxygen at any pressure;

b) other oxidizing gases (as defined in ISO 10156) having a minimum valve test pressure of 30 bar;

NOTE The threshold value of 30 bar was chosen to exclude specific oxidizing gases (e.g. chlorine) not requiring oxygen pressure surge testing based on minimum cylinder test pressures given in Packing Instruction P 200 of the UN Model Regulations.

c) gas mixtures, other than natural air or pre-mixed synthetic air, containing oxygen at any oxygen partial pressure or other oxidizing gases with a partial pressure greater than 30 bar.

The oxygen pressure surge test is not required if only metallic materials and lubricants rated for a pressure not less than p_{vt} are used in the oxygen wetted area of the valve.

If the valve is leaking (e.g. audible sound, pressure drop) during oxygen pressure surge testing, the test sample shall be considered to have failed the test.

The valve and its non-metallic components after being oxygen pressure surge tested shall undergo a visual examination and not show any traces of ignition (e.g. surface deterioration including change in surface texture and/or colour, material loss) and no components shall be displaced (no longer in place where it was installed) due to testing, non-functional (e.g. broken) or missing. It might be necessary to compare the tested sample with a non-oxygen tested sample from the other type tests.

The oxygen pressure surge test is specified in Annex C.

5.8 Resistance to acetylene flashback

To verify resistance to acetylene flashback for valves for acetylene service, the tests specified in Annex B shall be carried out.

NOTE Historically, this resistance was tested using an acetylene flashback test. The two tests in Annex B were developed to safely demonstrate the strength of the valve and its ability to resist leak using test parameters that simulate a flashback.

5.9 Manufacturing tests and examinations

Manufacturing tests and examinations shall be carried out in accordance with Annex D.

6 Type testing

6.1 General

6.1.1 Evaluation of conformity shall be carried out in accordance with the applicable regulations of the countries of use.

To conform to this document, valves shall be type tested.

A type test is valid for a given valve design.

6.1.2 Some changes within the valve design which could adversely affect valve performance require tests to be repeated using the number of test samples quoted in Table 2 including:

a) increase of valve test pressure (repetition of all tests except drop test, if required);

b) change in gas service (addition of oxygen pressure surge test or acetylene tests, if intended for such service); in addition, the compatibility between each new gas or gas mixture and the used materials shall be verified;

c) changes of corresponding filling connector (repetition of oxygen pressure surge test, if flow passage dimensions are changed);

d) changes of the valve body material (repetition of any tests to be decided case by case depending on changes of chemical composition and mechanical properties);

e) changes of the basic design dimensions of the valve components, e.g. inner spindle diameter, seat diameter, dimension of o-ring(s) and diaphragm thickness (repetition of tests to be decided case by case depending on the change);

f) changes of metallic material of the valve operating mechanism components, e.g. gland nut, spindle, diaphragm and springs (repetition of tests to be decided case by case depending on the change);

g) changes of the valve filling connection gas passage geometry, e.g. diameter and flow impingement angles (repetition of oxygen pressure surge test, if intended for oxygen service, for the critical connection(s) only, to be decided case by case depending on the change);

h) changes of the thread and/or any dimension of the valve inlet connection (only repetition of impact/drop test, if required, and hydraulic test, to be decided case by case depending on the change);

i) integration or removal of optional components (repetition of any tests to be decided case by case depending on the change). Removal of a pressure relief device will not require any tests to be repeated. Integration of a pressure relief device will require repetition of hydraulic burst pressure test and impact/drop test (if required) only;

j) changes of the o-ring and/or washer material of a valve parallel inlet connection (repetition of impact/drop test).

6.1.3 Material variants within a valve design (e.g. for reasons of compatibility between gas and non-metallic material) require repetition of only the relevant parts of the type test using a reduced number of test samples for the leak tightness and endurance test.

The test samples for leak tightness tests and endurance test shall be as follows.

a) If no material variants are specified, five test samples (nos. 2 to 6) of the basic valve design shall be tested (see Table 2).

b) If one material variant (a) is specified, three test samples (nos. 2, 3 and 4) of the basic specification and two test samples (nos. 5a and 6a) of the material variant shall be tested.

c) If two or more material variants (a, b, etc.) are specified, two test samples (nos. 2 and 3) of the basic specification and two test samples of each material variant (nos. 4a and 5a, 4b and 5b, etc.) shall be tested.

Examples of components which might constitute material variants include:

— o-ring/back-up ring;

— seat insert;

— lubricant;

— spring;

— adhesives;

— thrust washer;

— gasket.

6.2 Documentation

The manufacturer shall make available to the test laboratory:

a) a set of drawings consisting of the assembly drawing, parts list, material specifications including material standard for metallic materials and certificates (for the materials used for test samples), and drawings of sufficient details to conform to test sample verification (any change and/or material variant within the given valve design shall be clearly identified) including information about lubricants and adhesives, their approximate amounts and where they are applied;

b) drawings or other documentation giving sufficient details to identify the filling connector for valves used for oxidizing gases. This information may also be submitted by a third party;

c) information on markings;

d) a description of the valve and method of operation (including information on the interface with the valve operating device and minimum and maximum stroke);

e) information on the intended use of the valve [gases and gas mixtures, valve working or test pressure, service temperatures if outside of the normal temperature range (see 5.1), use with or without permanent valve protection, etc.];

   1) if the valve will be used without permanent valve protection, the maximum total package mass shall be specified;

   2) it shall be clearly indicated which gases and gas mixtures can be used with each valve material variant;

f) certificates of material compatibility, if not covered by ISO 11114-1 or ISO 11114-2.

6.3 Test samples

The test samples shall be in a condition that the manufacturer intends to supply, prior to any test or test preparation. Complete valves shall be submitted as test samples; except for valves designed to incorporate pressure relief devices, their ports shall be plugged or sealed. Valves designed to incorporate pressure gauges or pressure indicators shall have these devices fitted during type testing only where their performance can influence the outcome of the test with the exception of the hydraulic burst pressure test.

The valves shall be submitted with the corresponding valve operating device or an equivalent device or with the respective drawings allowing manufacturing such a device.

If oxygen pressure surge testing is required (see 5.7), the test samples shall be supplied with the corresponding filling connector.

The number of test samples for testing a valve design is given in Table 2. Additional test samples can be required for changes or for material variants within the valve design in accordance with the requirements of 6.1.

The test samples after being tested shall be rendered unserviceable or shall be clearly marked as test samples to avoid entering into service.

6.4 Test report

A written report shall be issued summarizing the tests carried out and the results obtained, and shall include or reference the documentation listed in 6.2 and, if applicable:

a) number of endurance cycles and service conditions, if greater than required;

b) pressure rise time determined during the oxygen pressure surge test and information on the cycles needed for its calibration.

This report shall be signed by the responsible person(s) of the test laboratory.

6.5 Test temperatures

The test temperatures are given in Table 2.

6.6 Test pressures

6.6.1 Valve burst test pressure

For compressed gases, p_{vbt} is given by Formula (1):

$$p_{vbt} = 1{,}5 \times 1{,}5 \times p_w = 2{,}25 \times p_w \quad (1)$$

For liquefied gases, p_{vbt} is given by Formula (2):

$$p_{vbt} = 1{,}5 \times p_{vt} \quad (2)$$

For acetylene, p_{vbt} shall be 909 bar (see B.1).

NOTE The test pressure is calculated as 26 bar absolute pressure × 35 [this represents a pressure multiplier that derives from an acetylene detonation plus reflection (see EIGA IGC 123/13)], minus 1 bar (in order to consider gauge pressure as opposed to absolute pressure).

6.6.2 Valve test pressure

For compressed gases, p_{vt} is given by Formula (3):

$$p_{vt} = 1{,}2 \times p_w \quad (3)$$

For acetylene and liquefied gases (e.g. carbon dioxide) p_{vt} shall be at least equal to the minimum test pressure quoted in the relevant transport regulation for that gas or gas group. Where the transport regulation does not specify a minimum test pressure, the test pressure marked on the cylinder for which the valve is intended shall be used.

NOTE Some regulations require the valve test pressure to correspond with the valve outlet connection pressure rating.

6.7 Test gases

6.7.1 Gas quality

Gas quality shall correspond to Table 1.

Table 1 — Gas quality

Parameter	Oxygen	All other gases (including air)
Dew point ≤−40 °C at atmospheric pressure[a]	Yes	Yes
Oil content ≤0,1 mg/m^3	Yes	Yes
Minimum purity ≥99,5 % by volume	Yes	No
Hydrocarbon content ≤0,01 % by volume	Yes	No
Maximum particle size ≤40 µm	Yes	Yes
[a] These values are identical to Class 2 requirements in ISO 8573-1:2010. NOTE Standard industrial gases normally meet the above requirements.		

6.7.2 Leak tightness tests

In general, the leak tightness tests should be carried out with air or nitrogen. Other gases may be used if agreed between the manufacturer and the test laboratory, provided that p_{vt} can be achieved.

For valves for helium, hydrogen or their mixtures, the test gas for the tightness tests after the endurance test shall be helium, hydrogen or an inert mixture of these gases.

WARNING — Caution should be taken during handling and testing with hydrogen due to flammability risks. Proper training, procedures and precautions shall be in place prior to testing.

6.7.3 Endurance test

In general, the endurance test should be carried out with air or nitrogen. Other gases may be used if agreed between the manufacturer and the test laboratory.

6.7.4 Oxygen pressure surge test

The oxygen pressure surge test shall be carried out with oxygen.

6.8 Test schedule

The tests shall be carried out in accordance with the schedule given in Table 2.

Table 2 — Test schedule for type testing (valve design without material variants)

Test	Test and relevant subclause	Condition of test sample	Test temperature °C	Test pressure bar	Test sample number	Number of tests per sample	Total number of tests
1	Hydraulic burst pressure, 6.9	As received	Room temperature[a]	p_{vbt}	1	1	1
2	Internal/ external leak tightness, 6.10	As received	Room temperature[a]	In accordance with Table 3	2 to 6[b]	6[b]	30[b]
3	Endurance, 6.11	From test 2	Room temperature[a]	p_{vt}	2 to 6[b,c]	1	5[b,c]
4	Internal leak tightness, 6.10.2.3	From test 3	$-40^{\ 0}_{-5}$	p_{vt}	2 to 6[b]	1[b]	5[b]
5	Internal/ external leak tightness, 6.10	From test 4	$-20^{\ 0}_{-5}$	In accordance with Table 3	2 to 6[b]	6[b]	30[b]
6	Internal/ external leak tightness, 6.10	From test 5	$+65^{+2,5}_{-2,5}$	In accordance with Table 3	2 to 6[b]	6[b]	30[b]
7	Internal/ external leak tightness, 6.10	From test 6	Room temperature[a]	In accordance with Table 3	2 to 6[b]	6[b]	30[b]
8	Visual examination, 6.12	From test 7	Room temperature[a]	—	2 to 6[b]	1	5[b]
9 (if required, see 5.4.2)	Impact, A.1, or drop, A.2	As received	Room temperature[a]	In accordance with Annex A	7[d]	1	1[d]
10 (if required, see 5.8)	Acetylene burst pressure, B.1	As received	Room temperature[a]	909	8a to 10a	1	3
11 (if required, see 5.8)	Acetylene seat leak tightness, B.2	As received (without soft seal)	Room temperature[a]	p_{vt}	11a to 13a	1	3
12 (if required, see 5.7)	Oxygen pressure surge, Annex C	As received (for valves with lubricants rated for valve test pressure, see 5.2) or pre-conditioned via endurance cycling procedure (test 3) (for valves with lubricants not rated for valve test pressure, see 5.2)	In accordance with Annex C	p_{vt}	8o to 10o	1	3

[a] Typically between 15 °C and 30 °C.

[b] For additional material variants, test sample numbers and number of tests will change (see 6.1).

[c] For valves required being pre-conditioned before oxygen pressure surge testing (see 5.2), three test samples in addition shall be tested.

[d] In case of drop testing, for non-axial-symmetric designs, four test samples are required.

6.9 Hydraulic burst pressure test

Valves for acetylene shall be tested in accordance with B.1.

The burst pressure test shall be carried out with the valve seat in open position (valve outlet/filling connection(s) closed). The test shall be carried out with the corresponding valve operating device or an equivalent device fitted.

Water or another suitable liquid shall be used as test medium.

The hydraulic pressure shall be applied via the valve inlet connection and be raised continuously and gradually until at least p_{vbt} is reached. The pressure shall be maintained for at least 2 min.

6.10 Leak tightness tests

6.10.1 General

Each internal and external leak tightness test temperature sequence (see Table 2) shall comprise the test pressures as given in Table 3 in increasing order for room and high temperature tests and decreasing order for –20 °C test.

NOTE This order was chosen to reflect normal cylinder operations.

Table 3 — Test pressures for leak tightness tests

0,5 bar
10 bar
p_{vt} (see 6.6.2)

Prior to the test, the valves shall achieve the relevant test temperature as given in Table 2 and shall be maintained at that temperature throughout the complete test procedure.

After the valves are tested at low temperatures, allow the test samples to naturally come to room temperature before applying high temperature to avoid temperature shocks between tests.

6.10.2 Internal leak tightness test

6.10.2.1 General

The internal leak tightness shall be determined for each of the submitted test samples in accordance with 6.10.2.2 and 6.10.2.3.

The internal leak tightness test shall be carried out on a closed valve without the valve operating device fitted.

6.10.2.2 Test at room and high temperature

The test shall be carried out in the following order.

a) The pressure shall be applied to the valve inlet and be raised until the test pressure is reached.

b) Wait at least 1 min before measuring the seat leakage rate.

NOTE Some valve designs require extended time before measuring the leak due to trapped air in the non-gas wetted area.

This test sequence shall be repeated for each test pressure given in Table 3. Before applying the next test pressure, it is allowed to vent the valve.

6.10.2.3 Test at low temperatures

The test shall be carried out in the following order.

a) The pressure shall be applied to the valve inlet and be raised until the test pressure is reached.

b) For the leak tightness test at −40 °C, the valve then shall be cooled down, avoiding temperature shocks. It shall be ensured that after cooling the valve down, it is at test pressure before measuring the leakage rate.

c) Wait at least 1 min before measuring the seat leakage rate.

NOTE Some valve designs require extended time before measuring the leak due to trapped air in the non-gas wetted area.

This test sequence shall be repeated for each test pressure given in Table 3 except for the test at −40 °C where only p_{vt} is required. Before applying the next test pressure, it is allowed to vent the valve. To carry out the tests at −20 °C, it is only necessary to raise the temperature without passing through room temperature.

6.10.3 External leak tightness test

The external leak tightness test shall only be carried out if there are valve sealing components which are not pressurized when the valve is in the closed position.

The external leak tightness test shall be carried out with the corresponding valve operating device or an equivalent device fitted.

The external leak tightness shall be determined for each of the submitted test samples in the following order.

a) Blank all existing openings of the valve except the one used to apply the test pressure.

b) Open the valve with the valve operating device or equivalent device.

c) The pressure shall be applied to the selected opening and be raised until the test pressure is reached.

d) Wait at least 1 min before measuring the total leakage rate.

NOTE Some valve designs require extended time before measuring the leak due to trapped air in the non-gas wetted area.

This test sequence shall be repeated for each test pressure given in Table 3. Before applying the next test pressure, it is allowed to vent the valve.

6.11 Endurance test

An endurance test of 2 000 cycles (opening and closing) shall be carried out at p_{vt} using axial movement only (e.g. by pushing a pin).

The test sample shall be cycled through its maximum stroke specified by the manufacturer [see 6.2 d)].

The valve inlet shall be pressurized to p_{vt}. During opening of the valve, the gas will automatically be released to atmosphere through the valve outlet. An inlet pressure decrease during release is acceptable, provided that p_{vt} is ensured at the beginning of each cycle.

There shall be a pause of at least 3 s at each closed position and of at least 0,5 s at each open position.

The test shall be performed at no more than 10 cycles per minute. The manufacturer may specify a cycle rate meeting this requirement. The cycle rate shall avoid extreme temperature effects such as freezing.

6.12 Visual examination

When the endurance test and the subsequent leak tightness tests have been completed, the valve shall be subjected to a visual examination.

During the visual examination, verification that the valve and its components correspond to the submitted set of drawings shall be carried out and recorded.

7 Marking

Valves conforming to this document shall be durably and legibly marked in service with the following:

a) coded identification of this document, i.e. “ISO S”;

b) manufacturer’s identification;

c) year and month (or week) of manufacture, i.e. YY/MM (or YY-WW) or YYYY/MM (or YYYY-WW);

d) identification of the valve inlet connection if it is not already required by the relevant inlet connection standard. This identification shall be given by a unique alphanumeric code such as that given in ISO/TR 11364;

e) identification of the valve outlet connection if it is not already required by the relevant outlet connection standard. This identification shall be given by a unique alphanumeric code identified by the manufacturer;

f) identification of the valve filling connection if separate to the valve outlet connection and if it is not already required by the relevant filling connection standard. This identification shall be given by a unique alphanumeric code identified by the manufacturer;

g) for valves meeting the requirement of 5.4.2, the maximum 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, breathing applications or upon request.

NOTE Attention is drawn to the requirements for marking in relevant regulations that might override the requirements in this document. The relevant transport regulation might require additional marking.

Annex A
(normative)

Mechanical strength tests

A.1 Impact test

The test sample shall be tested in the closed condition. The test sample shall be fitted into a steel gas cylinder neck equipped with the corresponding screw thread or a similar test fixture made of steel (see Figure A.1). The valving procedure shall meet the requirements of ISO 13341 or other industry standards, or be carried out according to the manufacturer's published installation procedures. It has to be verified that the threaded joint between the valve and the cylinder/test fixture does not leak before impact testing.

For taper threads, the test sample shall be fitted using the minimum of all given torque values for the tested valve inlet connection or the minimum torque value specified by the valve manufacturer. For parallel threads, the test sample shall be fitted using the maximum of all given torque values for the tested valve inlet connection or the maximum torque value specified by the valve manufacturer.

The test sample shall be struck by a plummet weight, tipped with a 13 mm diameter hardened steel ball. At impact, the plummet weight and hardened steel ball assembly shall have a minimum velocity of 3 m/s and an impact energy (in Joules) numerically equal to at least 3,6 times the total package mass in kilograms, with a relative tolerance of ±2,5 % or (40 ± 1) J, whichever is greater.

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

The impact shall be at 90° to the longitudinal axis of the test sample 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 inlet connection thread meets the cylinder (cylinder top) to the furthest point of the valve body, measured along the longitudinal (valve inlet connection) axis of the valve (see Figure A.1).

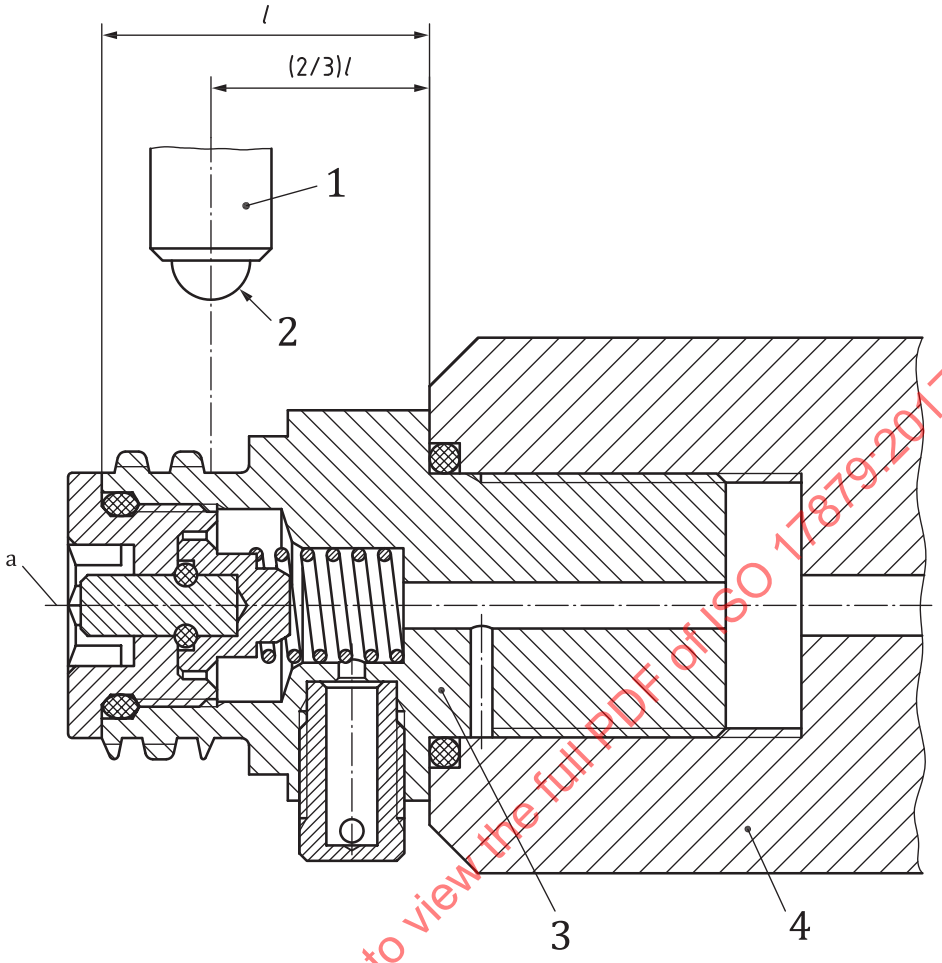
The point of impact at that location shall be chosen such that the weakest position of the valve body will be tested but shall not be obstructed by features such as outlet connecting threads, pressure-relief devices, handwheel, etc.

If the calculated point of impact for the test cannot be used (e.g. due to installed features/components or configuration of the valve body, such as those found in "Y"-shaped cylinder valves), a different point of impact shall be chosen and a corrected impact energy value calculated and used.

The test sample shall be struck once only.

The closed test sample shall then be hydraulically pressure tested with p_{vt}. Water or another suitable liquid shall be used as test medium. The hydraulic pressure shall be applied via the valve inlet connection and be raised continuously and gradually until at least p_{vt} is reached. The pressure shall be maintained for at least 2 min.

After the hydraulic pressure test, an internal leak tightness test at room temperature with the test sample remaining in the closed position shall be carried out using p_{vt} only. The total leakage (comprising that from the valve internal sealing system plus that from the threaded joint between the valve and the cylinder/test fixture) shall not exceed 100 cm^3/h. Any leakage shall not result from cracking of the valve body.



Key

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

Figure A.1 — Impact test fixture

A.2 Drop test

For this test, the test sample shall be fitted to a test cylinder, filled with a quantity of water or other substance so as to equal the maximum total package mass.

The valving procedure shall meet the requirements of ISO 13341 or other industry standards, or be carried out according to the manufacturer's published installation procedures. For taper threads, the test sample shall be fitted using the minimum of all given torque values for the tested valve inlet connection or the minimum torque value specified by the valve manufacturer. For parallel threads, the test sample shall be fitted using the maximum of all given torque values for the tested valve inlet connection or the maximum torque value specified by the valve manufacturer.

The assembly of valve and test cylinder shall be dropped vertically from a height of 1,20 m onto an impact surface.

The impact surface shall be a concrete block of at least 1 m × 1 m by 0,1 m thick. The block shall be protected by a sheet of steel of at least 10 mm thick. The flatness of the protective sheet shall be such

that the difference in level of any two points on its surface shall not exceed 2 mm. It shall be changed when it is significantly damaged.

Prior to drop testing, the assembly shall be suspended with the cylinder longitudinal axis at an angle of 30° to the vertical, the valve directed downwards. The angle may be reduced to ensure the impact is absorbed by the valve and not the cylinder. There shall be a distance of 1,20 m between the lowest point of the valve and the impact surface.

For an axial-symmetric design, one test sample shall be tested. The valve shall be subjected to the drop test at one single impact point.

For other designs, four test samples of the same type shall be tested. In this case, the drop test shall be carried out at four points, an equal 90° apart, on the top circumference of the valve. Each of the four valves shall be subjected to the drop test at one single impact point.

The leak tightness of the valve and the threaded joint between the valve and the cylinder shall be verified after the drop test by pressurizing the cylinder to a pressure between 1 bar and 3 bar. It is sufficient to check the leakage using a leak detection fluid. The cylinder may be pressurized before or after the drop test. If no leakage is observed, it has to be ensured that the cylinder is still pressurized.