INTERNATIONAL STANDARD

ISO 10297

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Gas cylinders — Refillable gas cylinder valves — Specification and type testing

Bouteilles à gaz — Robinets de bouteilles à gaz rechargeables — Spécifications et essais de type

Reference number
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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 3.

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.

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

Annexes B and C form an integral part of this International Standard, annex A and the Bibliography are for information only.

Gas cylinders — Refillable gas cylinder valves — Specification and type testing

1 Scope

This International Standard specifies requirements for refillable gas cylinder valves and the method of testing such valves for type approval.

This International Standard is applicable to valves to be fitted to gas cylinders of up to 150 l water capacity, intended to convey compressed, liquefied or dissolved gases.

This International Standard is only applicable to valves operated by a hand wheel or a key.

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

Additional specific requirements for valves fitted with pressure-reducing, pressure-retaining and non-return devices are not covered by this International Standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing or heat-resistance tests*.

ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids*.

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

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

ISO 10920, *Transportable gas cylinders — 25E taper thread for connection of valves — Specification.*

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

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

ISO 11114-3, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 3: Autogenous ignition test in oxygen atmosphere*.

ISO 11116-1, *Gas cylinders — 17E taper thread for connection of valves to gas cylinders — Part 1: Specifications*.

ISO 11117, *Gas cylinders — Valve protection caps and valve guards for industrial and medical gas cylinders — Design, construction and tests*.

3 Definitions and symbols

For the purposes of this International Standard, the following definitions and symbols apply.

3.1
working pressure
p_w
settled pressure, at a uniform temperature of 15 °C, for a full gas cylinder

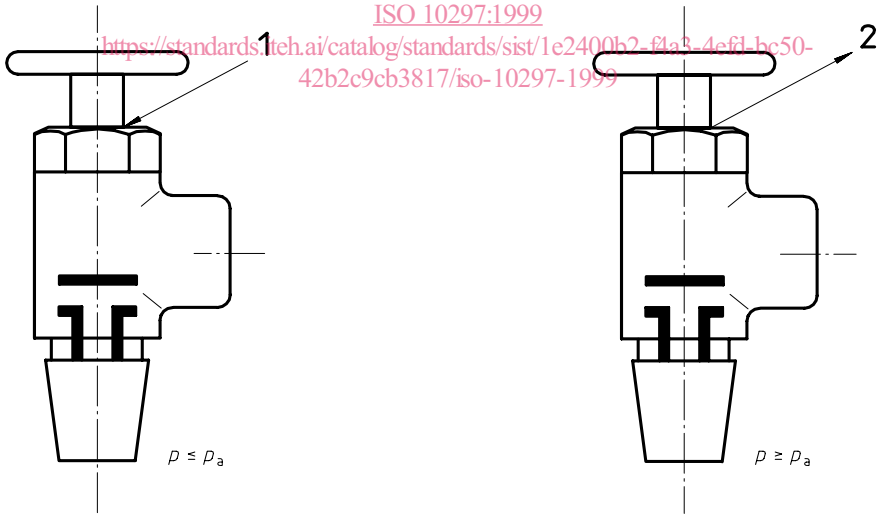
3.2
operating pressure
p_o
varying pressure which is developed in a cylinder during service

3.3
valve test pressure
p_{vt}
for permanent gases:

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

For liquefied gases and dissolved gases under pressure (for example, acetylene), p_{vt} shall be at least equal to the minimum test pressure of the cylinder quoted in the relevant transportation regulation for that gas or gas group.

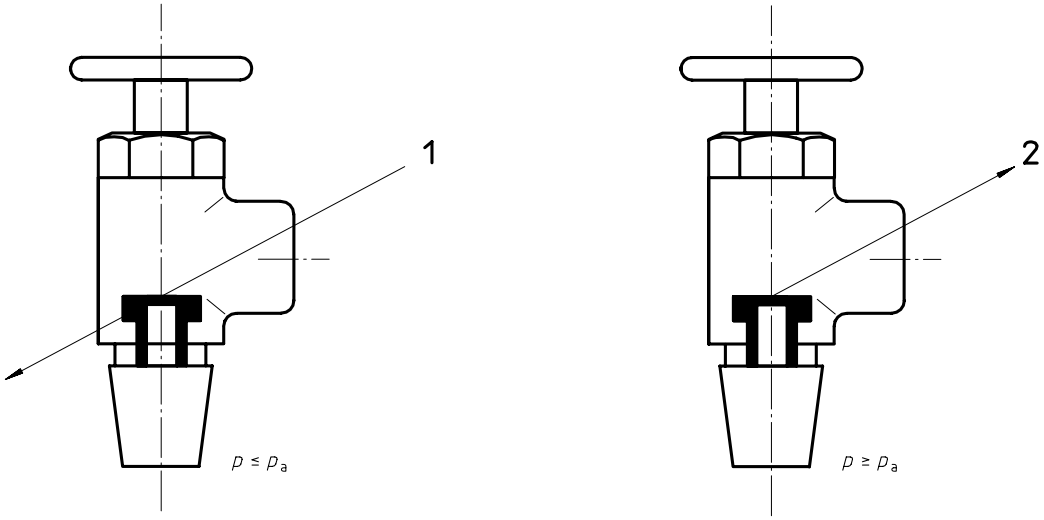
3.4
external tightness
tightness to atmosphere (leakage in and/or leakage out) when the valve is open (see Figure 1)



Key
p = internal pressure
p_a = atmospheric pressure
1 Leakage in
2 Leakage out

Figure 1 — External tightness

3.5
Internal tightness
tightness across the valve seat (leakage in and/or leakage out) when the valve is closed (see Figure 2)



Key
p = internal pressure
p_a = atmospheric pressure
1 Leakage in
2 Leakage out

Figure 2 — Internal tightness

3.6
minimum closing torque
T_c
minimum closing torque applied to valve operating mechanism necessary to obtain the internal tightness

3.7
resistance torque
maximum closing torque applied to valve operating mechanism which the valve can withstand without suffering damage

3.8
valve operating mechanism
manually rotated device, which closes and opens the valve orifice

4 Valve requirements

4.1 General

Valves shall operate satisfactorily over the full range of service temperatures, from − 20 °C to + 65 °C. 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 this.

Valves shall be capable of withstanding any mechanical stresses or chemical attack they may experience during normal service.

Valves shall be cleaned to meet the requirements of the intended service.

4.2 Description and dimensions

A cylinder valve comprises:

— a body;

— a valve operating mechanism and internal sealing device;

— an external sealing mechanism;

— a connection(s) for usage (fill and discharge);

— a connection system, between the valve and gas cylinder.

In addition, a valve may also comprise:

— a safety device, against overpressurization;

— a siphon tube;

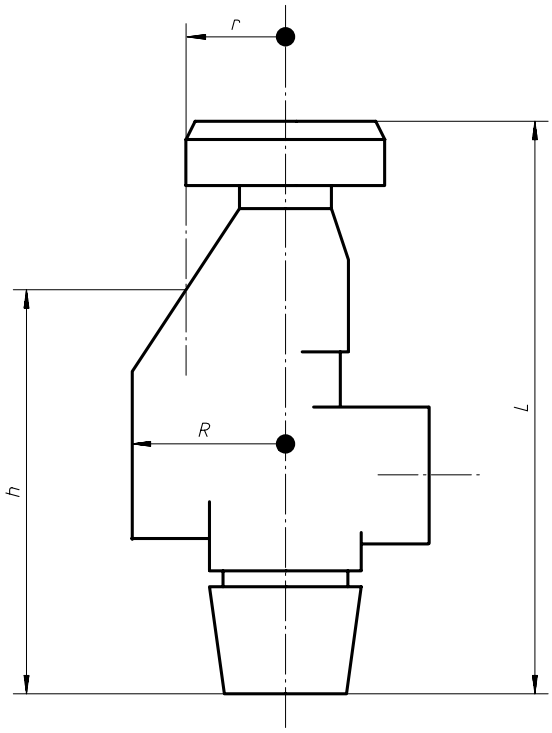
— a screwed plug or cap, on the outlet connection, to ensure leak tightness or protection;

— an excess flow limiting device;

— a filter.

The bore of the valve shall be adequate to meet the requirements of flow rate, without unacceptably reducing the strength of the stem connection. The bore diameter, typically 3,5 mm for valves with a 25E stem thread (see ISO 10920) and 2 mm for valves with a 17E stem thread (see ISO 11116-1), shall be agreed between customer and supplier.

Where a valve is to be protected by a cap in accordance with ISO 11117, the valve should comply with the dimensions given in Figure 3.



$r \leqslant 32{,}5$ mm
$h \leqslant 90$ mm
$R \leqslant 38$ mm
$L \leqslant 125$ mm

NOTE 1 h represents the height between the lower part of the valve and the point at which the overall radius of the valve is equal to the radius of the handwheel when the radius of the valve is greater than the radius of the handwheel.

NOTE 2 When the axes of the valve, the valve stem thread and handwheel do not coincide the distance between the two axes should be added to r.

NOTE 3 L is the maximum length of a valve in the closed position when not fitted to a cylinder.

NOTE 4 R should be measured to the part of the valve furthest from the stem axis and includes any outlet plugs or caps if fitted.

Figure 3 — Maximum dimensions for gas cylinder valves, protected by a cap

4.3 Materials

Metallic and non-metallic materials in contact with the gas shall be chemically and/or physically compatible with the gas, under all intended operating conditions (see ISO 11114-1 and ISO 11114-2).

Compatibility of materials with oxygen and other oxidizing gases, ignition resistance of materials and lubricants, shall be established by an appropriate test procedure (see ISO 11114-3).

Valves for acetylene may be manufactured from copper-based alloys if the copper content does not exceed 70 % (m/m). The manufacturer shall not use any procedure resulting in copper enrichment of the surface. Silver content of alloys shall be limited for acetylene valves. The acceptable limit varies between 43 % (m/m) and 50 % (m/m), depending on the composition of the alloy.

Non-metallic sealing material for use with air, oxygen and oxygen enriched gases, shall be capable of withstanding an ageing sensitivity test in accordance with ISO 188.

Non-metallic sealing material in valves shall be capable of withstanding corrosive media tests in accordance with ISO 1817.

4.4 Design and construction

4.4.1 Valve body

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, particularly that specified in 5.4.2. The anisotropy of the material shall be considered.

4.4.2 Valve connections

Valves are normally connected to the cylinder by means of a taper or parallel male thread and to the filling and utilisation appliances by means of a separate outlet connection, complying with an accepted standard.

4.4.3 Valve operating mechanism

The valve operating mechanism shall be manufactured from materials capable of withstanding mechanical stress including possible dynamic loads (eg., pressure shocks or cyclic changes) and the extremes of service temperature, to which it may be subjected.

The materials of the valve operating mechanism shall withstand fire engulfment in accordance with 5.4.10.

The valve operating mechanism shall satisfy the following conditions:

— it shall not be dependent on the pressure in the cylinder;

— it shall, under normal conditions, operate without difficulty throughout its service life;

— it shall be designed in such a way that it cannot be unscrewed from the valve body with a torque of less than 40 N·m;

— it shall be designed in such a way that the setting of the operating position of the valve, cannot be inadvertently altered;

— it shall close the valve by clockwise rotation;

— it shall be designed to ensure that lubricants that are not oxygen compatible, do not come into contact with highly oxidizing gases as defined in ISO 10156;

— for acetylene valves, it shall be designed to meet the requirements of 5.4.9.

For valves for oxygen or highly oxidizing gases, the opening of the valve orifice shall be progressive. Complete opening shall require more than one rotation of the operating mechanism. For valves, in which it is technically difficult to limit opening in this way (for example diaphragm valves) other means shall be provided to delay full gas flow.

4.4.4 Tightness

Methods of achieving external tightness include:

— gland packing;

— one or several O-rings;

— diaphragm;

— bellows;

— any other appropriate device.

External and internal tightness, shall be achieved over the full range of service pressures and temperatures.

The external tightness shall be maintained for all positions of the valve spindle, from the opening, to complete closing and during operation.

All sealing devices shall withstand 2 000 opening and closing cycles, at p_{vt}, without replacement of the sealing device. Adjustment is permitted.

The minimum gauge pressure, during the tightness test, shall be 0,1 bar. Where the valve is not intended for use with inflammable or toxic gases this pressure may be increased to 0,5 bar.

At the customer's request the tightness test may be carried out under vacuum.

When incorporating diaphragms or bellows, additional gland packings or O-rings, may be used to ensure safety, in case of deterioration of the diaphragms or the bellows. This particularly applies for toxic gases.

The tightness test is normally carried out with air or nitrogen. Valves designated for use with gases lighter than air, or very searching gases (for example carbon dioxide) may be subjected to a test using helium.

For the definition of an inflammable gas see ISO 10156, and for the definition of a toxic gas see annex A of ISO 5145.

4.4.5 Leakage rate

The internal or external leakage rate shall not exceed 6 cm^3/h at 20 °C and 1 013 mbar.

The specified rate may be amended by agreement and subject to special applications, eg., for valves for highly toxic or high purity gas service, a lower leakage rate may be specified.

4.4.6 Operating torque

For handwheel operated valves, with a handwheel diameter of 65 mm, the closing torque to obtain internal tightness, shall be 7 N·m or less. For certain valves (for example key operated or diaphragm valves) this torque may be higher. The size of the handwheel, or equivalent operating device, shall be appropriate for the required closing torque (see 5.4.3.2 and 5.4.6).

The torque necessary for the complete closing and opening of the valve, shall not increase significantly during the valve's service life (see 5.4.4).

5 Prototype valve test

5.1 General

Before valves are introduced into service, they shall be submitted for prototype approval (see 5.2 and 5.3). A prototype approval is valid for a given family of valves, having the same basic design.

Variations to connections do not require further prototype testing.

Changes to the internal components for reasons of gas/material compatibility (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 valve body material, constitute a new family and require the full type test.

5.2 Documents

The manufacturer shall make available to the test authority, 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;

— description of valve and method of operation;

— information on the field of application 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;

— certificates of material compatibility as required.

5.3 Test valves

A minimum of nine sample valves are required (more samples may 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 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 (a) is specified, three samples (Nos 2, 3, 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) is also used for the fire exposure test;

d) one sample (No. 7) for any additional test which may be required;

e) two samples (Nos. 8 and 9) for determination of operating torques.

In addition, for oxygen or highly oxidizing gas service, three sample valves (10n, 11n and 12n) are required for the oxygen pressure surge test and for acetylene service, three sample valves (10m, 11m, and 12m) are required for the internal tightness test after flashback.

5.4 Test procedure

5.4.1 Table of tests

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

See annex A, for an example of test sequence for a basic design with type variants.