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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

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO 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).

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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;

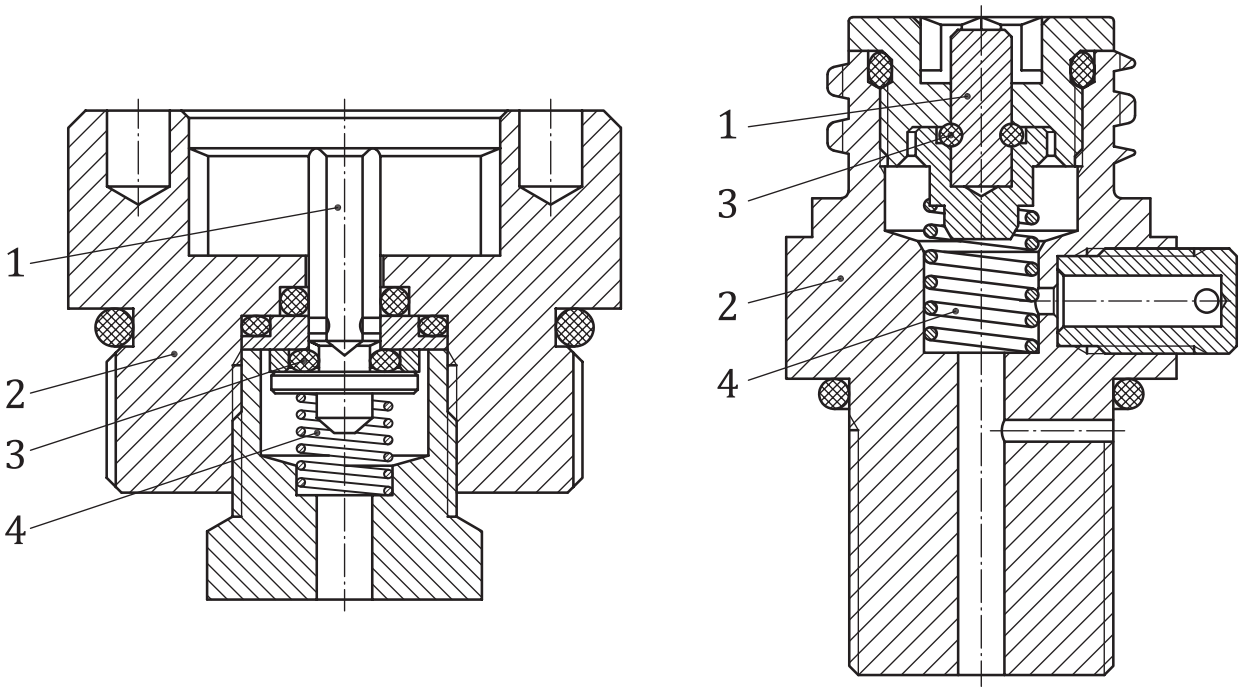
c) an outlet connection plug/cap;

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.

