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Gas cylinders — Cylinder valves with integrated pressure regulators — Specification and type testing

Bouteilles à gaz — Robinets de bouteilles avec détendeur intégré — Spécifications et essais de type

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

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 22435 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*.

Introduction

Cylinder valves with integrated pressure regulators are used to reduce the high cylinder pressure to a lower pressure suitable for use.

These functions cover a wide range of inlet and outlet pressures and flows which require specific design characteristics. It is important that the operating characteristics of these valves be specified and tested in a defined manner.

Such valves are more complicated than conventional cylinder valves yet subject to the same environmental and transportation conditions. These conditions should be borne in mind at the design and development stage.

This International Standard pays particular attention to

— suitability of materials,

— safety (mechanical strength, safe relief of excess pressure and resistance to ignition),

— gas-specificity,

— cleanliness,

— testing,

— identification, and

— information supplied.

Gas cylinders — Cylinder valves with integrated pressure regulators — Specification and type testing

1 Scope

This International Standard applies to cylinder valves with integrated pressure regulators (VIPR) intended to be fitted to gas cylinders that convey compressed, liquefied or dissolved gases.

This International Standard is not intended for medical applications (see ISO 10524-3). Further, additional specific requirements for valves fitted with safety valves and bursting discs (see EN 14513) and for valves fitted with residual pressure valves (see ISO 15996) are not covered by this International Standard.

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 2503:1998, *Gas welding equipment — Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar*

ISO 3253, *Gas welding equipment — Hose connections for equipment for welding, cutting and allied processes*

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

ISO 5171, *Pressure gauges used in welding, cutting and allied processes*

ISO 7289, *Quick-action couplings with shut-off valves for gas welding, cutting and allied processes*

ISO 7291:1999, *Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 300 bar*

ISO/TR 7470, *Valve outlets for gas cylinders — List of provisions which are either standardized or in use*

ISO 9090, *Gas tightness of equipment for gas welding and allied processes*

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

ISO 10920, *Gas cylinders — 25E taper thread for connection of valves to gas cylinders — 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 11117, *Gas cylinders — Valve protection caps and valve guards for industrial and medical gas cylinders — Design, construction and tests*

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

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

ISO 15996, *Gas cylinders — Residual pressure valves — General requirements and type testing*

EN 13918, *Gas welding equipment — Integrated flowmeter regulators used on cylinders for welding, cutting and allied processes — Classification, specification and tests*

3 Terms and definitions

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

3.1
adjustable pressure regulator
device that has been provided with a means of operator adjustment of the delivery pressure under normal use

3.2
closure pressure
P_4
stabilized outlet pressure, one minute after cessation of the flow, from a pressure regulator by which the flow has been set to a standard discharge

3.3
cylinder valve with integrated pressure regulator
VIPR
device intended to be permanently fitted to a gas cylinder connection and comprising a shut-off valve system and pressure reduction system

3.4
filling port
point on the device through which the cylinder is filled

3.5
flow characteristic
variation of the outlet pressure in relation to the rate of flow from zero to maximum capacity flow of the pressure regulator with the inlet pressure remaining constant

3.6
flow gauge
device that measures pressure and that is calibrated in units of flow

3.7
flowmeter
device that measures and indicates the flow of a specific gas or gas mixture

3.8
hysteresis
lagging of the outlet pressure (effect) when the flow (cause) is varied so that at a constant inlet pressure the values of outlet pressure measured with increasing flow do not coincide with the values of outlet pressure measured with decreasing flow

3.9
maximum discharge flow
Q_{max}
maximum flow which is delivered by the pressure regulator at the rated outlet pressure, p_2, and at the test inlet pressure, p_3

3.10
orifice
restriction of known cross-section that delivers a constant flow of gas when supplied with gas at a constant upstream pressure

3.11
pre-set pressure regulator
pressure regulator that has not been provided with a means of operator adjustment of the delivery pressure under normal use

3.12
pressure characteristic
variation of the outlet pressure with inlet pressure under specific initial flow conditions

3.13
pressure regulator
device for regulation of a generally variable inlet pressure to an outlet pressure as constant as possible

3.14
main shut-off mechanism
shut-off valve between the gas cylinder and the regulating mechanism of the device

3.15
rated outlet pressure
P_2
downstream pressure for the standard discharge, Q_1, specified in the instructions for use

3.16
pressure relief valve
device designed to release excess pressure from the outlet side of the pressure regulator at a pre-set value

3.17
secondary operating mechanism
means of setting the outlet discharge flow between zero and maximum

3.18
standard discharge
Q_1
flowrate, specified in the instructions for use for which the pressure regulator is designed to maintain a rated outlet pressure, p_2, at test inlet pressure, p_3

3.19
test inlet pressure
p_3
inlet pressure at which the standard discharge of the pressure regulator, Q_1, is measured and which is twice the rated outlet pressure, p_2, plus 100 kPa, i.e. p_3 = (2 p_2 + 100 kPa)

3.20
test outlet pressure
p_5
highest or lowest value of the outlet pressure resulting from a variation in the inlet pressure between p_1 and p_3 at previously adjusted conditions p_1, p_2, Q_1

3.21
valve test pressure
p_{vt}
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

3.22
working pressure
p_w
settled pressure, at a uniform temperature of 15 °C, for a full gas cylinder

NOTE 1 For compressed gases, p_w in this International Standard corresponds to p_1 in ISO 2503.

NOTE 2 This definition applies only to compressed gases and not to liquefied gases and dissolved gases (acetylene).

4 Symbols and terminology

The symbols used for the physical characteristics are given in Table 1.

Table 1 — Notations, symbols and designations

Symbol	Designation
p_w	Working pressure
p_{vt}	Valve test pressure
p_1	Inlet pressure
p_2	Rated outlet pressure
p_3	Test inlet pressure, (2 p_2 + 100) kPa
p_4	Closure pressure
p_{4max}	Maximum closure pressure
p_5	Test outlet pressure
Q_1	Standard discharge
Q_{max}	Maximum discharge
Q_{RV}	Discharge of the relief valve
R	Coefficient of pressure increase upon closure, $(p_4 - p_2)/p_2$
i	Irregularity coefficient, $(p_5 - p_2)/p_2$

5 Design requirements

5.1 General

VIPR shall operate satisfactorily over a 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 accordingly.

VIPR shall be capable of withstanding the mechanical stresses or chemical attack they may experience during intended service, e.g. during storage, valving into cylinders, filling processes, transportation and end use of the cylinder.

5.2 Description

This International Standard does not prescribe the components that the VIPR shall comprise.

A cylinder valve with integrated pressure regulator typically comprises

— a body,

— an inlet connection to the cylinder,

— a main shut-off mechanism (to isolate the device from the high pressure gas in the cylinder),

— a filling connection (it may be fitted with a non-return valve or an isolating valve),

— the pressure regulating mechanism(s),

— a pressure relief valve on the low pressure side of the regulating mechanism(s) and

— an outlet connection (for the end user).

A VIPR can also be fitted with

— a secondary operating mechanism to set the outlet flow,

NOTE Some devices can have both mechanisms, some others can have only one.

— a pressure relief device to protect the cylinder,

— a siphon tube,

— a screwed plug or cap on the outlet and/or the filling connection,

— an excess flow limiting device,

— a means of preventing the ingress of atmospheric air,

— a residual pressure retaining device (see ISO 15996),

— pressure indicator(s) on the high and/or low pressure sides of devices,

— a flow control device,

— a flow indicator (e.g. flowmeter or flow gauge) and

— filter(s).

5.3 Materials

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

Because of the risk of forming explosive acetylides, VIPR for acetylene may be manufactured from copper-based alloys only if the copper content does not exceed 70 % (by mass). The manufacturer shall not use any procedure resulting in copper enrichment of the surface. For the same reasons, silver content of alloys shall be limited for acetylene VIPR. The acceptable limit varies between 43 % (by mass) and 50 % (by mass), but in no case exceeds 50 % (by mass).

Ignition resistance in oxygen or other highly oxydising gases (see ISO 10156) of non-metallic materials and lubricants shall have been established by an appropriate test procedure (see ISO 11114-3). Where, during the filling of gas mixtures containing oxygen (even if the final mixture is less oxydising than air), there is the possibility that high pressure oxygen comes into contact with such material, the purchaser shall specify accordingly.

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

5.4 Pressure indicators

Devices other than pressure gauges may be used to indicate pressure or flow. Pressure indicators shall be of the fail-safe type, i.e. the operator shall not be injured in case of failure.

If pressure gauges are used, they shall comply with the safety features of ISO 5171. This applies also to pressure gauges used to indicate flow.

5.5 Filling connection

The filling connection shall be designed to handle the intended service conditions. It shall comply with ISO 5145, the relevant national standards (see ISO/TR 7470) or be a proprietary connection. If the filling connection is separate to the outlet connection and is not equipped with a non-return valve or isolating valve, it shall be provided with a pressure-tight device, e.g. a valve pressure plug or a cap which can be operated or removed only by the use of a special tool. Where applicable, such a device shall be designed to vent gas before becoming disengaged.

If the filling connection is made through the outlet connection, it shall be designed so that it does not interfere with a gas withdrawal connection made in accordance with the relevant national or International Standard.

The filling connection non-return valve, if fitted, shall comply with the requirements of 5.15 after testing as described in 6.15.

5.6 Cylinder connection

The connection to the cylinder shall be in accordance with international or national standards, (e.g. 25E, see ISO 10920).

If other connectors are used, evidence shall be provided by the manufacturer that an equivalent mechanical strength is achieved.

5.7 Outlet connection

The connection shall be either

a) a proprietary fitting; if a quick connection is used, it shall comply with the endurance tests of ISO 7289 or

b) a welding hose connection (e.g. ISO 3253 for a threaded connection or ISO 7289 for a quick connection or other regional or national standards) or

c) a high pressure cylinder valve outlet connection (e.g. ISO 5145).

If a residual pressure valve is fitted to the outlet connection, it shall be designed so that it does not interfere with a gas withdrawal connection made in accordance with the relevant standard.

5.8 Outlet pressure for acetylene

For acetylene, the closure pressure p_4 shall not exceed 1,5 bar for all inlet pressures when the pressure adjusting device is fully charged.

5.9 Flow control valve (flow controller)

If a flow control valve is fitted, the flow control knob and the valve spindle shall be captive such that they cannot be dismantled without the use of a tool.

Compliance shall be tested by attempting to remove the knob and spindle without the use of a tool.

5.10 Pressure adjusting device

The pressure adjusting device, if fitted, shall be captive and shall be removable only by the use of a tool. The VIPR shall be designed so that the pressure regulator valve cannot be held in the open position as a consequence of the pressure regulator spring being compressed to its solid length and thereby allowing gas to pass from the high pressure to the low pressure side. For VIPR designed to allow filling of the cylinder through the outlet connection, a special tool may be used to hold the pressure regulator valve open for filling only.

Compliance shall be tested by visual inspection.

5.11 Filtration

The pressure regulator valve seat shall be protected from particulates contamination (e.g. by the use of a filter). A dust filter, having an effective cross-section compatible with the discharge, shall be mounted within the pressure regulator upstream of the pressure regulator valve. The filter shall retain particles greater than or equal to 0,1 mm.

5.12 Main shut-off valve

The main shut-off mechanism shall meet the requirements given in 5.15 after 2 000 opening and closing cycles. The test is described in 6.14.1.

If the main shut-off valve is the pressure regulator valve itself, an endurance test shall be performed according to 6.14.2. The requirements stated in 5.15 shall be respected after 100 000 cycles.

5.13 Flow and pressure performance for regulators without flow metering devices

5.13.1 Flow performance and characteristics

The standard discharge, Q_1, and the rated outlet pressure, p_2, shall be in accordance with the values stated by the manufacturer.

The test method for the standard discharge, Q_1, and rated outlet pressure, p_2, is given in 6.6.2.

The test method for the flow characteristic is given in 6.6.3.

5.13.2 Coefficient of pressure increase upon closure R

The coefficient R shall be less than 0,3 when determined in accordance with 6.6.4.

5.13.3 Irregularity coefficient i

The coefficient i shall be within the limits $\pm$ 0,3 when determined in accordance with 6.6.5.