INTERNATIONAL STANDARD

ISO 15996

Second edition
2017-07

Gas cylinders — Residual pressure valves — Specification and type testing of cylinder valves incorporating residual pressure devices

Bouteilles à gaz — Robinets à pression résiduelle — Spécifications et essais de type de robinets de bouteille intégrant des dispositifs de pression résiduelle

Reference number
ISO 15996:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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.

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*.

This second edition cancels and replaces the first edition (ISO 15996:2005), which has been technically revised. It also incorporates the Amendment ISO 15996:2005/Amd 1:2007.

The main changes compared to the previous edition are as follows:

a) Title and scope: extension to cover the complete RPV (valve including the residual pressure device) and not the RPD (residual pressure device) only; informative reference to ISO 10297 was modified;

b) Scope: inclusion of main valves, valves with integrated pressure regulator (VIPRs) and RPVs for pressure drums and tubes; exclusion of dissolved gases, possible application for RPD stand-alone devices;

c) Terms, definitions and symbols: introduction of new definitions and adaptation of existing definitions; introduction of different types of RPDs to replace the old descriptions and change of order (type A became type 2 and type B became type 1);

d) Valve design considerations: inclusion of design considerations with addition of informative Annex A;

e) Performance requirements and considerations:

   1) Closing-off pressure and opening pressure: introduction of requirements for opening pressure and closing-off pressure, especially of a minimum value for the closing-off pressure;

   2) Endurance: reduction of number of endurance cycles for type 2 RPDs;

   3) Visual examination: introduction of visual examination at the end of the complete test procedure;

4) Resistance of the non-return function against pressure in the reverse direction for type 1 RPDs: exclusion of RPDs in VIPRs and adaptation of pass-fail requirements;

5) Leak tightness in the reverse direction for type 1 RPDs: exclusion of RPDs in VIPRs;

6) Integrity under high flow: exclusion of RPDs when installed outside the filling path in a VIPR;

f) RPV type testing:

1) General: introduction of information on how to deal with changes within the RPV design;

2) Test samples: addition of requirement to submit the test samples for oxygen pressure surge testing with the relevant filling connector(s);

3) Test gases: introduction of requirements on the use and quality of the test gases;

4) Test schedule: adaptation to meet the new requirements, addition of test pressure and test temperature; deletion of information on variants;

5) Strength test of the non-return function in the reverse direction for type 1 RPD tests: decrease of number of test samples to one;

6) Verification of opening pressure and closing-off pressure: addition of verification at low and high temperature; addition of detailed test procedure;

7) Leak tightness test in the reverse direction for type 1 RPDs: modification and clarification of tightness test in the flow direction; addition of test at 0,5 bar in the reverse direction;

8) Visual examination: addition of visual examination to the test sequence;

9) Oxygen pressure surge test: information transferred to normative Annex B; addition of test for main valves; addition of detailed information on test procedure;

g) Marking: introduction of marking requirements;

h) Annex A (informative): deletion of examples of RPV designs; introduction of design considerations;

i) Annex B (normative): information on test equipment transferred to informative Annex D; new Annex B giving mandatory requirements on oxygen pressure surge test;

j) Annex C (informative): update of MIL standard reference for vibration test;

k) Annex D (informative): complete modification of integrity under high flow test (reduction of number of test samples, adaptation of gases for which an additional test with carbon dioxide should be carried out, change from liquid carbon dioxide to gaseous carbon dioxide as test gas, modification of test procedure);

l) Annex E: new informative Annex E giving information on test equipment (former Annex B).

Introduction

Increased requirements to avoid contamination of gases and cylinders have led to the development of valves incorporating residual pressure devices (RPDs) hereinafter referred to as residual pressure valves (RPVs).

These devices are designed to maintain a positive pressure relative to atmosphere within the cylinder by closing off its internal gas passages in the discharging direction. This prevents the cylinder from being completely emptied in customer use and stops ingress of atmospheric contamination if the valve operating mechanism (main shut-off) is left open. Many of these devices include a non-return function that protects the cylinder from backflow from downstream processes.

This document has been written so that it is suitable for the application of the UN Model Regulations.

Considering the changes described in the Foreword, when an RPV has been approved according to the previous version of this document, the body responsible for approving the same RPV to this new edition should consider which tests need to be performed.

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

Gas cylinders — Residual pressure valves — Specification and type testing of cylinder valves incorporating residual pressure devices

1 Scope

This document specifies design, type testing and marking requirements for cylinder valves incorporating residual pressure devices, hereinafter referred to as residual pressure valves (RPVs). This document applies to the following types of RPVs:

a) cylinder valves intended to be fitted to refillable transportable gas cylinders;

b) main valves (excluding ball valves) for cylinder bundles;

c) cylinder valves or main valves with integrated pressure regulator (VIPR);

d) valves for pressure drums and tubes;

which convey compressed or liquefied gases.

NOTE Where there is no risk of ambiguity, cylinders, pressure drums, tubes and cylinder bundles are addressed with the collective term "cylinder" within this document.

These requirements are in addition to those in ISO 10297.

For RPD stand-alone devices this document can also be applied.

This document does not apply to RPVs for portable fire extinguishers, cryogenic equipment, low pressure refrigerant gases (cylinder test pressure less than 50 bar), dissolved gases or liquefied petroleum gas (LPG).

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 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 given in ISO 10286, ISO 10297 and the following apply.

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

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

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

3.1
residual pressure valve
RPV
valve which incorporates a *residual pressure device* (3.2)

Note 1 to entry: The term "valve" covers the valves listed in Clause 1, a) to d).

3.2
residual pressure device
RPD
device that is designed to prevent ingress of contaminants by maintaining a positive pressure within the cylinder relative to atmosphere by closing off its internal gas passages in the discharging direction

Note 1 to entry: This definition might be different to definitions given in applicable transport regulations.

3.3
type 1 RPD
RPD (3.2) that retains a positive pressure in the cylinder above the pressure downstream of the valve outlet and also incorporates a non-return feature to prevent backflow into the cylinder from a higher pressure on the valve outlet

Note 1 to entry: Cylinders with RPVs with a type 1 RPD located between the filling port and cylinder cannot be filled or vacuumed unless the RPD is neutralized or a special fill connector is used to overcome the non-return feature.

3.4
type 2 RPD
RPD (3.2) that retains a positive pressure in the cylinder above atmospheric pressure but will not prevent backflow into the cylinder if the pressure on the valve outlet is high enough to overcome the RPD mechanism and the residual pressure in the cylinder

Note 1 to entry: Cylinders with RPVs with a type 2 RPD can be filled with a conventional fill connector, but, if located between the filling port and cylinder, cannot be vacuumed or vented below the closing-off pressure unless the RPD is neutralized or a special fill connector is used.

3.5
discharging direction
path taken by gas through the *RPD* (3.2) when flowing out of the cylinder through the outlet connection

3.6
reverse direction
path taken by gas towards the *RPD* (3.2) in the opposite direction to the *discharging direction* (3.5)

3.7
filling direction
path taken by gas through the *RPV* (3.1) when filling the cylinder

Note 1 to entry: Depending on the design of the *RPV* (3.1), filling direction and *reverse direction* (3.6) might be the same.

3.8
opening pressure
differential pressure between upstream pressure and downstream pressure of the *RPD* (3.2) at which the RPD starts to open to allow gas to flow in the *discharging direction* (3.5)

Note 1 to entry: Due to the effects of manufacturing tolerances this is normally expressed as a pressure range.

3.9
closing-off pressure
cylinder pressure at which leak tight closure of the *RPD* (3.2) is achieved during gas withdrawal through the outlet connection

Note 1 to entry: Due to the effects of manufacturing tolerances and different discharge rates this is expressed as a pressure range.

3.10
RPV working pressure
p_w
settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full cylinder for which the *RPV* (3.1) 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 RPV working pressure is expressed in bar.

3.11
RPV test pressure
p_{vt}
pressure applied to a *RPV* (3.1) during testing

Note 1 to entry: The RPV test pressure is a minimum value and is expressed in bar.

3.12
NTP
normal temperature and pressure i.e. 20,0 °C (293,15 K), 1,013 bar absolute (0,101 3 MPa absolute)

3.13
RPV filling connector
device fitted to the filling connection of *RPVs* (3.1) fitted with *type 1 RPDs* (3.3) during filling to overcome the non-return feature and for both *type 1* and *type 2 RPDs* (3.4) during venting and vacuuming

Note 1 to entry: These connectors are design-specific and usually not standardized.

3.14
standard connector
device that is manufactured to an international, regional or national standard which is fitted to the valve filling connection of a valve with or without *RPD* (3.2) to allow users to withdraw gas from the cylinder and which can also be used to fill cylinders having *RPVs* (3.1) fitted with type 2 *RPDs* (3.4)

Note 1 to entry: These connectors are usually standardized.

3.15
RPD neutralization device
device fitted to *RPVs* (3.1) with type 2 *RPDs* (3.4) to neutralize the *RPD* (3.2) if so designed and intended to be neutralized during filling and vacuuming

4 RPV design considerations and requirements

4.1 Design considerations

Design considerations are given in 4.1.1 to 4.1.2 and Annex A.

4.1.1 Resistance against vibration

RPDs should resist leakage of gas due to vibration experienced in transport.

An example of a vibration test is given in Annex C.

4.1.2 Integrity under high flow

RPDs, except when installed outside the filling path in a VIPR, should be able to withstand the dynamic and thermal loads created by the gas flow during cylinder filling and venting.

An example of an integrity under high flow test is given in Annex D.

NOTE This test covers the practice of venting cylinders prior to filling followed by the cylinder filling process. It ensures that the seals within the RPD are not displaced or damaged by the high mass flows, high velocities and low temperatures involved.

4.2 Design requirements

4.2.1 General

RPDs 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.

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

4.2.2 Valve outlet connection

To accommodate the RPD, the internal dimensions of the RPV outlet connection are permitted to differ from those quoted in the relevant outlet connection standard, provided safety and performance are not compromised and the modified design does not conflict with corresponding standard connectors.

4.3 Performance requirements for RPDs

4.3.1 Requirements for type 1 and type 2 RPDs

4.3.1.1 Opening pressure and closing-off pressure

The opening pressure and closing-off pressure at room temperature shall meet manufacturer's specifications. In addition, the opening pressure and closing-off pressure at low and high temperatures (see Table 2) shall be measured and recorded to ensure that the RPD functions over the specified temperature range (see 4.2.1).

To ensure confident and reliable pre-fill checking of cylinders fitted with RPVs, the closing-off pressure at room temperature shall be no less than 1,5 bar. For specific applications, the closing-off pressure at room temperature may be reduced if agreed between the manufacturer and the purchaser.

NOTE Applicable regulations and/or standards (e.g. ISO 10524-3) or purchasers can require a higher minimum closing-off pressure.

The verification of opening pressure and closing-off pressure is given in 5.9.2.

4.3.1.2 Leakage

Leakage shall not exceed 6 cm^3/h corrected to NTP over the range of temperatures specified in Table 2.

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

4.3.1.3 Endurance

RPDs shall meet the requirements for the opening pressure given in 4.3.1.1 after endurance testing.

NOTE This requirement is in addition to the endurance test specified in ISO 10297, where the RPV is to be tested with the RPD neutralized using the manufacturer's recommended method or by using a RPV not fitted with the RPD.

The endurance test is given in 5.9.3.

After the endurance test and the subsequent tests/verifications have been performed a visual examination shall be carried out to ensure that no component is displaced (according to the manufacturer's drawing), non-functional (e.g. broken or damaged) or missing.

The visual examination is given in 5.9.5.

4.3.1.4 Resistance to ignition

If required by ISO 10297:2014, 5.9, an oxygen pressure surge test shall be carried out.

The oxygen pressure surge test is given in Annex B, except for VIPRs where the test shall be carried out according to ISO 22435 for industrial applications or ISO 10524-3 for medical applications.

4.3.2 Additional requirements for type 1 RPDs

4.3.2.1 Resistance of the non-return function against pressure in the reverse direction for type 1 RPDs

Except when installed in a VIPR, type 1 RPDs shall be able to resist a hydraulic pressure of 1,5 × p_{vt} in the reverse direction without permanent visible deformation of the metallic components, damage of non-metallic materials or bursting of the RPD.

NOTE Generally, the strength of all RPVs via the RPV inlet connection is covered by ISO 10297.

The strength test of the non-return-function in the reverse direction for type 1 RPDs is given in 5.9.1.

4.3.2.2 Leak tightness in the reverse direction for type 1 RPDs

Except when installed in a VIPR, type 1 RPDs shall meet the leakage requirements given in 4.3.1.2 at 0,5 bar and p_{vt} applied in the reverse direction. The leak tightness test in the reverse direction for type 1 RPDs is given in 5.9.4.

NOTE This test is in addition to the tightness tests given in ISO 10297.

5 RPV type testing

5.1 General

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

To comply with this document, RPVs shall be type tested.

A type test is valid for a given RPV design.