



**International  
Standard**

**ISO 10297**

**Gas cylinders — Cylinder valves —  
Specification and type testing**

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

**Fourth edition  
2024-04**

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Published in Switzerland

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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 document 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 23, *Transportable gas cylinders*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 10297:2014), which has been technically revised. It also incorporates the Amendment ISO 10297:2014/Amd. 1:2017.

The main changes are as follows:

- clarification of the Scope concerning different VIPR designs;
- addition of several new terms and definitions, e.g. VIPR types A, B and C for easy referencing of different design types;
- oxygen pressure surge test:
  - for VIPRs transferred from ISO 22435 and amended,
  - for RPVs transferred from ISO 15996 and amended,
  - reference for test equipment and procedure to ISO 11114-6,
- endurance test for specific VIPR designs transferred from ISO 22435 and amended;
- endurance test of the filling connection non-return valve transferred from ISO 22435 with clarification of the test procedure without changes to the acceptance criteria;
- acetylene decomposition test of VIPR designs transferred from ISO 22435 and amended;
- subclause 5.3 "Dimensions" removed;
- introduction of [Table 2](#) for giving the different leakage rates depending on the valve design;

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- [Table 4](#) (former Table 3) of test schedule amended;
- introduction of recommendations for flow capacity values and reference to CGA V-9 for the respective determination as an example;
- introduction of a valve spindle impact test for pin-index valves not permanently protected during transport and use;
- introduction of the hydraulic pressure test also in the closed position for manually operated valves;
- introduction of an additional tightness test for pressure relief valves located upstream of the valve operating mechanism;
- Annex D "Example of test schedule" removed;
- information on changes and/or material variants within a valve design moved to new [Annex F](#) and amended.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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## Introduction

This document has been written so that it is suitable to be referenced in the UN Model Regulations.

The term “pressure receptacle” is used within this document to cover instances where no differentiation is necessary between gas cylinders, bundles of cylinders, pressure drums and tubes.

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 ( $1 \text{ bar} = 10^5 \text{ Pa} = 10^5 \text{ N/m}^2$ ).

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

Any tolerances given in this document include measurement uncertainties.

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# Gas cylinders — Cylinder valves — Specification and type testing

## 1 Scope

This document specifies design, type testing and marking requirements for:

- a) cylinder valves intended to be fitted to refillable transportable gas cylinders;
- b) main valves (excluding ball valves) for bundles of cylinders;
- c) cylinder valves or main valves with integrated pressure regulator (VIPR);

NOTE 1 This includes the following specific VIPR designs where:

- 1) The pressure regulating system is acting as the primary valve operating mechanism (VIPR type B). This also includes designs where closure of the primary valve operating mechanism is obtained by closing the seat of the pressure regulating mechanism.
- 2) The primary valve operating mechanism is located at the low-pressure side of the pressure regulating system (VIPR type C).

- d) valves for pressure drums and tubes;

which convey compressed, liquefied or dissolved gases.

NOTE 2 Where there is no risk of ambiguity, cylinder valves, main valves, VIPRs and valves for pressure drums and tubes are addressed with the collective term “valves” within this document.

This document does not apply to

- valves for cryogenic equipment, portable fire extinguishers and liquefied petroleum gas (LPG);
- quick-release cylinder valves (e.g. for fire-extinguishing, explosion protection and rescue applications) - requirements for quick-release cylinder valves are specified in ISO 17871 which contains normative references to this document;
- self-closing cylinder valves and ball valves.

NOTE 3 Requirements for valves for cryogenic vessels are specified in ISO 21011 and at a regional level, e.g. in EN 1626. Requirements for LPG valves are specified in ISO 14245 or ISO 15995. Requirements for self-closing cylinder valves are specified in ISO 17879. Requirements for ball valves are specified in ISO 23826. Requirements for valves for portable fire extinguishers at a regional level are specified, for example, in the EN 3 series.

This document only covers the function of a valve as a closure. Other functions that are possibly integrated in the valve can be covered by other standards. Such standards do however not constitute requirements according to this document.

NOTE 4 Definition of and specific requirements for VIPRs in addition to those that are given in this document are specified in ISO 22435 for industrial applications or ISO 10524-3 for medical applications. Similarly, certain specific requirements for residual pressure valves (RPV) with or without a non-return function in addition to those that are given in this document are given in ISO 15996.

NOTE 5 Certain specific requirements for valves for breathing apparatus in addition to those that are given in this document are specified at a regional level, for example, in the EN 144 series. Certain specific requirements for quick-release valves for fixed fire-fighting systems in addition to those that are given in this document are specified in ISO 16003 and at a regional level, for example, in EN 12094-4.

NOTE 6 Requirements for manufacturing tests and examinations of valves covered by this document are given in ISO 14246.

## 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 10286, *Gas cylinders — Vocabulary*

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 11114-6, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 6: Oxygen pressure surge testing*

ISO 11117, *Gas cylinders — Valve protection caps and guards — Design, construction and tests*

ISO/TR 11364, *Gas cylinders — Compilation of national and international valve stem/gas cylinder neck threads and their identification and marking system*

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

ISO 15615:2022, *Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — Safety requirements in high-pressure devices*

## 3 Terms and definitions

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

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **valve design**

classification of valves with regard to the *valve operating mechanism* (3.10)

### 3.2

#### **main valve**

valve which is fitted to the manifold of a bundle of cylinders, battery vehicle, battery wagon or multiple-element gas containers (MEGC) isolating it from the main connection(s)

### 3.3

#### **residual pressure valve**

##### **RPV**

valve which incorporates a *residual pressure device* (3.4)

### 3.4

#### **residual pressure device**

##### **RPD**

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

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

**3.5**  
**valve with integrated pressure regulator**  
**VIPR**

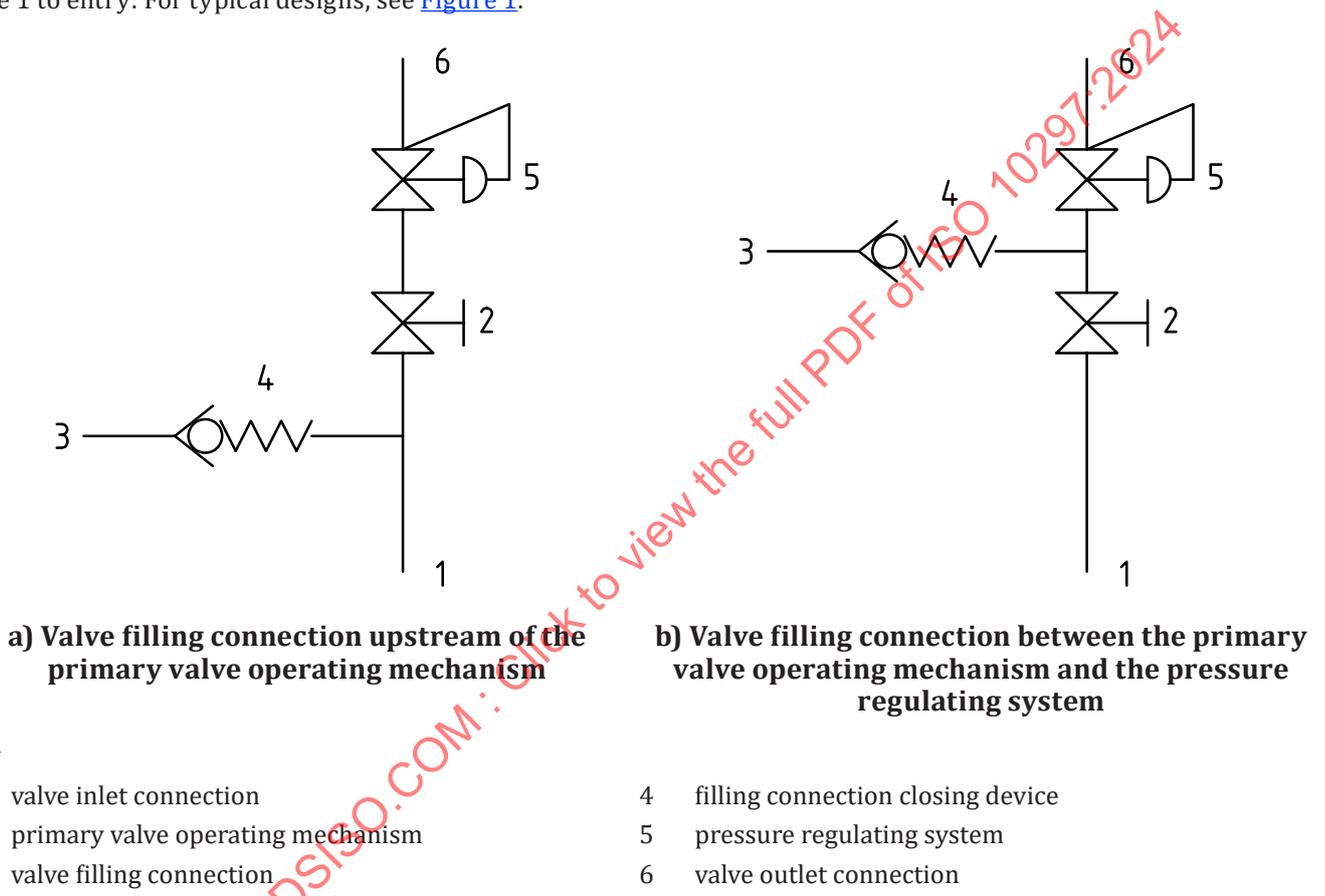
device intended to be permanently fitted to a pressure receptacle which comprises of at least a shut-off function and pressure regulating system

Note 1 to entry: A VIPR used as a *main valve* (3.2) is covered by this definition.

**3.6**  
**VIPR type A**

VIPR design where the *primary valve operating mechanism* (3.10) is located upstream of the *pressure regulating system* (3.9)

Note 1 to entry: For typical designs, see [Figure 1](#).

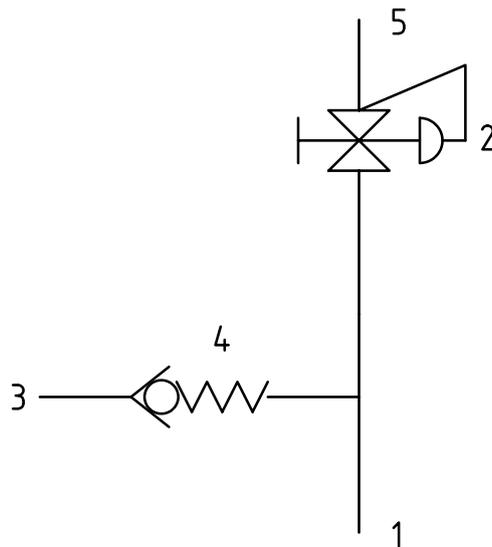


**Figure 1 — General structure of VIPR type A designs**

**3.7**  
**VIPR type B**

VIPR design where the *pressure regulating system* (3.9) is also acting as the *primary valve operating mechanism* (3.10)

Note 1 to entry: See [Figure 2](#).



**Key**

- |   |  |   |                                   |
|---|--|---|-----------------------------------|
| 1 | valve inlet connection   | 4 | filling connection closing device |
| 2 | pressure regulating system including primary valve operating mechanism | 5 | valve outlet connection           |
| 3 | valve filling connection   |   |                                   |

**Figure 2 — General structure of a VIPR type B design**

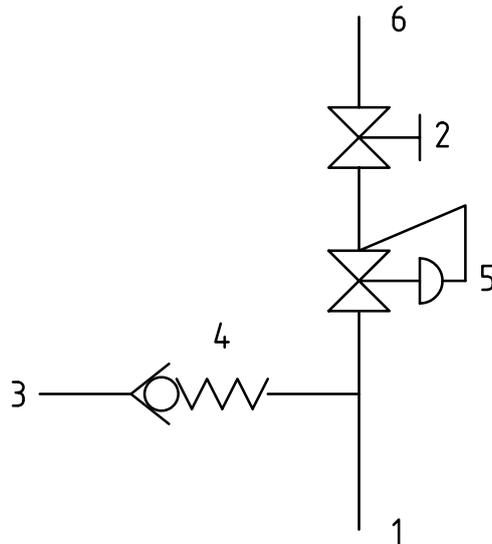
**3.8**

**VIPR type C**

VIPR design where the primary *valve operating mechanism* (3.10) is located downstream of the *pressure regulating system* (3.9)

Note 1 to entry: The primary valve operating mechanism can be a flow selector.

Note 2 to entry: See [Figure 3](#).



**Key**

- |   |                                   |   |                                   |
|---|-----------------------------------|---|-----------------------------------|
| 1 | valve inlet connection            | 4 | filling connection closing device |
| 2 | primary valve operating mechanism | 5 | pressure regulating system        |
| 3 | valve filling connection          | 6 | valve outlet connection           |

**Figure 3 — General structure of a VIPR type C design**

**3.9 pressure regulating system**

device(s) that reduce(s) the inlet pressure to a controlled outlet pressure

Note 1 to entry: A pressure regulating system can comprise of one or more stages of pressure regulation.

Note 2 to entry: The pressure regulating system can be either adjustable (adjustable pressure setting) or pre-set (fixed pressure setting).

**3.10 valve operating mechanism**

mechanism which closes and opens the valve orifice, and which includes the internal and external sealing systems

EXAMPLE A threaded valve spindle which, when rotated, raises and lowers a seal/seat.

Note 1 to entry: For a VIPR, the valve operating mechanism is called the primary valve operating mechanism.

Note 2 to entry: For a VIPR type B, the pressure regulating system is also acting as the primary valve operating mechanism.

**3.11 valve operating device**

component which actuates the *valve operating mechanism* (3.10)

EXAMPLE Handwheel (including knob), key, toggle, lever or actuator.

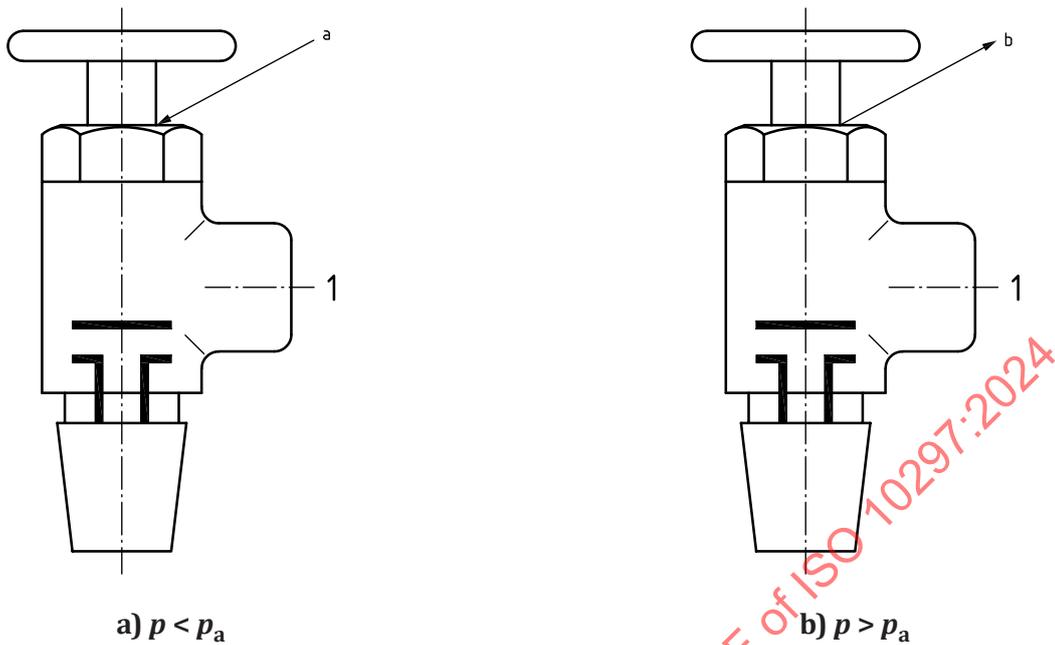
**3.12 external leak tightness**

leak tightness to atmosphere (leakage in and/or leakage out) when the valve is open

Note 1 to entry: The total external leakage typically comprises that from the valve external sealing system plus, for example, pressure relief device, RPD, pressure indicating devices and pressure regulating system.

Note 2 to entry: See [Figure 4](#).

Note 3 to entry: Leakage in describes a leak resulting in a flow direction into the valve during vacuum testing. Leakage out describes a leak resulting in a flow direction out of the valve.



**Key**

- 1 valve outlet connection (sealed)
- $p$  internal pressure
- $p_a$  atmospheric pressure
- a Leakage in (vacuum test).
- b Leakage out.

**Figure 4 — External leak tightness**

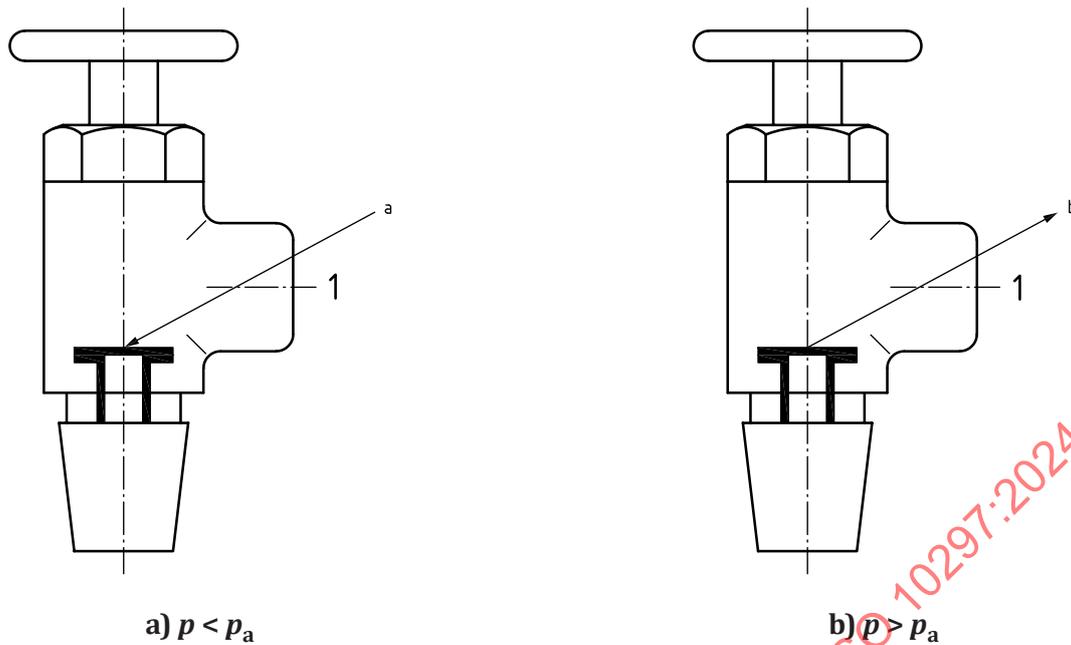
**3.13**

**internal leak tightness**

leak tightness across the valve seat (leakage in and/or leakage out) when the valve is closed

Note 1 to entry: See [Figure 5](#).

Note 2 to entry: Leakage in describes a leak resulting in a flow direction into the valve during vacuum testing. Leakage out describes a leak resulting in a flow direction out of the valve.



**Key**

- 1 valve outlet connection (open)
- $p$  internal pressure
- $p_a$  atmospheric pressure
- a Leakage in (vacuum test).
- b Leakage out.

**Figure 5 — Internal leak tightness**

**3.14 leak tightness in transport and storage conditions**

leak tightness across any closing device (e.g. valve seat, filling connection closing device, outlet connection closing device) and integrated pressure retaining components (e.g. active pressure gauge, pressure relief device) located upstream of the closing device, when the valve is closed

Note 1 to entry: For valves without any integrated pressure retaining components located upstream the valve seat, the leak tightness in transport and storage conditions corresponds to the *internal leak tightness* (3.13).

**3.15 valve working pressure**

$p_w$   
settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full pressure receptacle 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).

**3.16 valve hydraulic test pressure**

$p_{vht}$   
minimum pressure applied to a valve during the hydraulic pressure test

**3.17 valve test pressure**

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

**3.18  
handwheel diameter**

$D$   
nominal value of twice the largest radius from the centre of the handwheel

**3.19  
minimum closing torque**

$T_c$   
torque necessary to be applied to a *valve operating device* (3.11) of a newly manufactured valve to obtain *internal leak tightness* (3.13) at *valve test pressure* (3.17) and room temperature

Note 1 to entry: The minimum closing torque is expressed in Nm.

**3.20  
endurance torque**

$T_e$   
closing torque applied during the endurance test

Note 1 to entry: The endurance torque is expressed in Nm.

**3.20.1  
endurance torque at start**

$T_{e,start}$   
*endurance torque* (3.20) to be applied at the beginning of the endurance test

**3.20.2  
endurance torque at end**

$T_{e,end}$   
*endurance torque* (3.20) measured at the end of the endurance test to achieve *internal leak tightness* (3.13)

**3.21  
excessive torque**

torque applied in opening and closing direction in excess of specified operating torques

Note 1 to entry: Excessive torques are differentiated in *over torques* (3.21.1 and 3.21.2) and *failure torques* (3.21.3).

**3.21.1  
over torque**

$T_o$   
opening or closing torque (whichever is the lower value) applied to the *valve operating device* (3.11) to determine the level of torque which the *valve operating mechanism* (3.10) can tolerate and remain operable

Note 1 to entry: The over torque is expressed in Nm.

**3.21.2  
over torque for a VIPR type B**

$T_{ob}$   
torque applied to the *valve operating device* (3.11) in opening and closing direction which the *valve operating mechanism* (3.10) and/or *stop mechanism for a VIPR type B* (3.22) can tolerate and remain operable

Note 1 to entry: This torque also applies to a VIPR type C with the flow selector acting as the primary valve operating mechanism.

Note 2 to entry: The over torque is expressed in Nm.

**3.21.3  
failure torque**

$T_f$   
opening or closing torque (whichever is the lower value) applied to the *valve operating device* (3.11) to obtain mechanical failure of the *valve operating mechanism* (3.10) and/or *valve operating device* (3.11)

Note 1 to entry: The failure torque is expressed in Nm.

### 3.22

#### **stop mechanism for a VIPR type B**

system which limits the position of the *valve operating device* (3.11)

Note 1 to entry: This also applies to a VIPR type C with the flow selector acting as the primary valve operating mechanism.

### 3.23

#### **total package mass**

combined mass of a gas cylinder, pressure drum or tube (including, for dissolved gases, any porous material and solvent), 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.

### 3.24

#### **valve inlet connection**

connection on the valve which connects the valve to the pressure receptacle

### 3.25

#### **valve outlet connection**

connection on the valve used to discharge the pressure receptacle

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

### 3.26

#### **valve filling connection**

connection on the valve used to fill the pressure receptacle

Note 1 to entry: For some valves (e.g. VIPRs), the valve filling connection is different from the valve outlet connection.

### 3.27

#### **filling connection closing device**

closing device located in the *valve filling connection* (3.26)

EXAMPLE Non-return valve, isolating valve.

## 4 Valve description

4.1 A valve typically comprises:

- a) valve body;
- b) valve operating mechanism;
- c) valve operating device;
- d) means to ensure internal leak tightness;
- e) means to ensure external leak tightness;
- f) valve outlet connection(s);
- g) valve inlet connection;

4.2 Valves can also include:

- a) pressure relief device;

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NOTE The relevant transport regulation can require or forbid pressure relief devices for some gases, gas mixtures or gas groups. Additional requirements for pressure relief devices can exist in international/regional regulations/standards.

- b) dip tube;
- c) outlet connection plug/cap;
- d) excess flow device;
- e) filling connection closing device (e.g. non-return valve, isolating valve);
- f) RPD with or without non-return function;
- g) pressure regulating system;
- h) separated valve filling connection (i.e. separated from the valve outlet connection, e.g. for a VIPR);
- i) flow restricting orifice;
- j) filter(s).

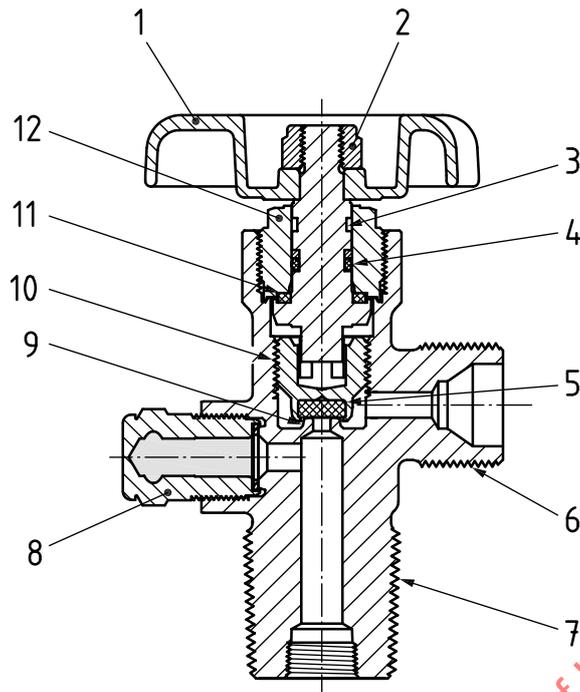
Not all of these components have test requirements detailed in this document.

### 4.3 Common valve designs are:

- a) o-ring gland seal valves (see [Figure 6](#));
- b) diaphragm gland seal valves (see [Figure 7](#));
- c) compression packed gland seal valves (see [Figure 8](#));
- d) pressure seal valves (see [Figure 9](#));
- e) reverse seated valves (see [Figure 10](#)).

The valve designs shown in [Figures 6](#) to [9](#) (reproduced from CGA V-9—2019 with permission from Compressed Gas Association (CGA)) are given as typical examples, each with one sealing system and one valve operating device only.

A pin-index (post-type medical) valve (see [Figure 11](#), reproduced from CGA V-9—2019 with permission from Compressed Gas Association (CGA)) is shown for illustration purposes to show a valve outlet connection geometry in common medical gas cylinder applications.

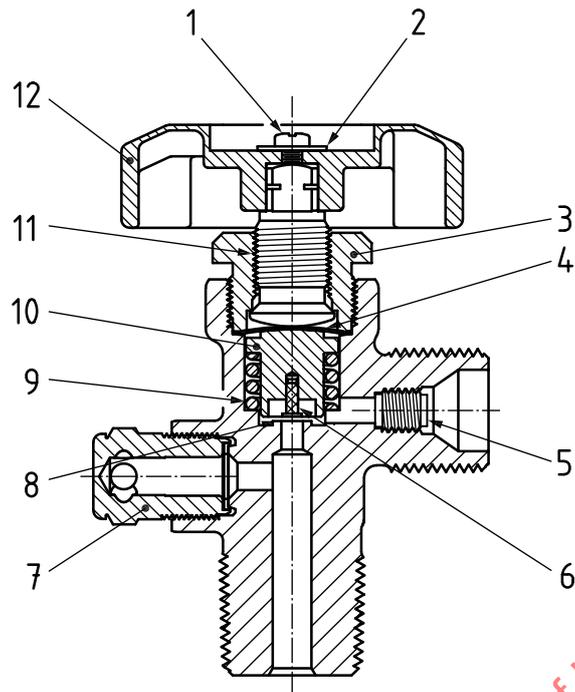


**Key**

- 1 handwheel
- 2 handwheel retaining nut
- 3 upper spindle
- 4 o-ring
- 5 seat insert
- 6 valve outlet connection
- 7 valve inlet connection
- 8 pressure relief device
- 9 body seat
- 10 lower spindle
- 11 washer
- 12 gland nut

**Figure 6 — O-ring gland seal valve  
(non-metallic seal, handwheel operated)**

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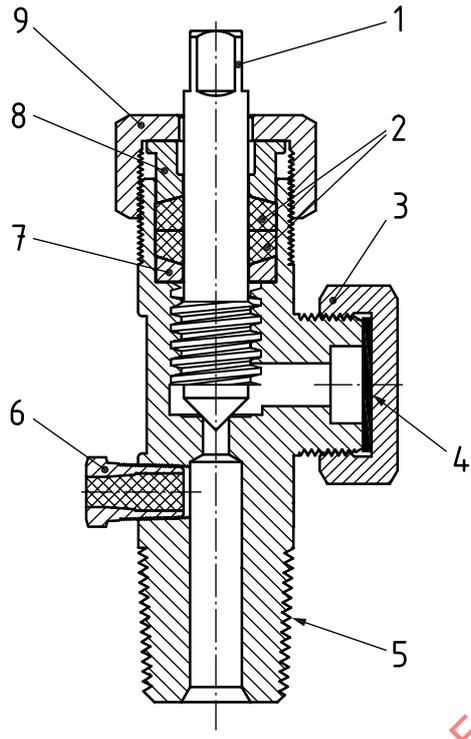


**Key**

- 1 handwheel retaining screw
- 2 washer
- 3 gland nut
- 4 diaphragms
- 5 flow restrictor (when specified)
- 6 seat insert
- 7 pressure relief device
- 8 body seat
- 9 seat opening spring
- 10 lower spindle
- 11 upper spindle
- 12 handwheel

**Figure 7 — Diaphragm gland seal valve  
(non-metallic seal, handwheel operated)**

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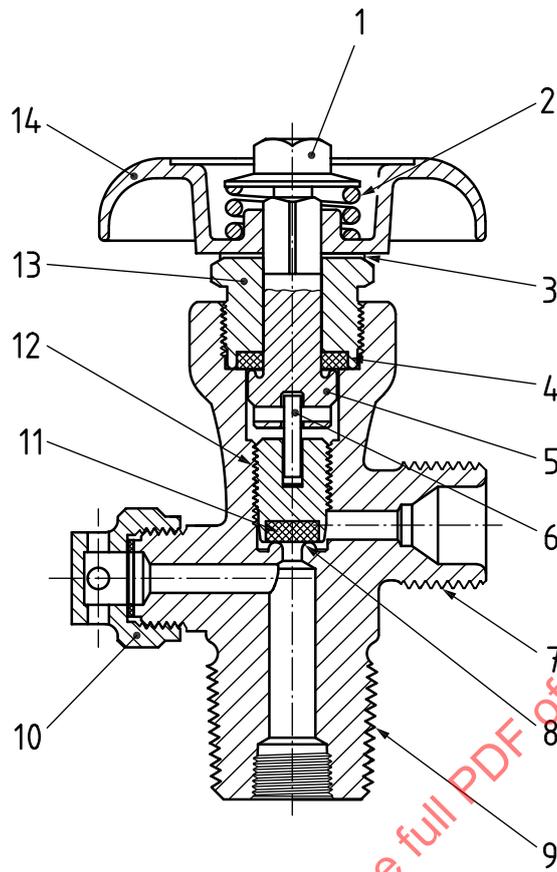


**Key**

- 1 spindle, one-piece
- 2 packings
- 3 cap nut/outlet connection cap
- 4 outlet seal gasket
- 5 valve inlet connection
- 6 pressure relief device
- 7 packing collar
- 8 packing gland
- 9 packing nut

**Figure 8 — Compression packed gland seal valve (metal to metal seal, key operated)**

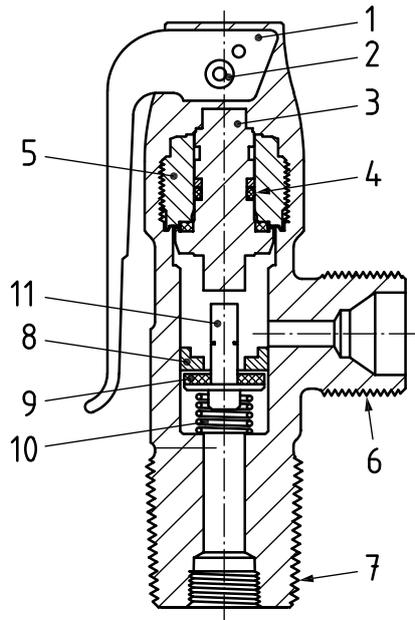
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**Key**

- 1 handwheel retaining nut
- 2 pressure seal loading spring
- 3 washer
- 4 packings
- 5 upper spindle
- 6 tang
- 7 valve outlet connection
- 8 body seat
- 9 valve inlet connection
- 10 pressure relief device
- 11 seat insert
- 12 lower spindle
- 13 gland nut
- 14 handwheel

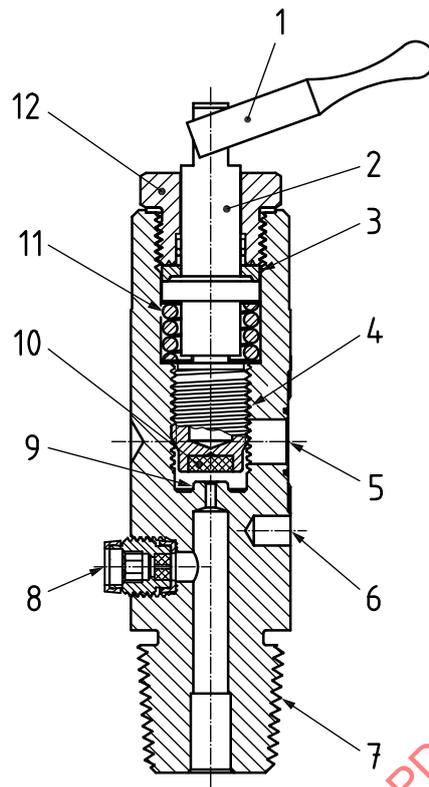
**Figure 9 — Pressure seal valve  
(non-metallic seal, handwheel operated)**



**Key**

- |   |                         |    |                        |
|---|-------------------------|----|------------------------|
| 1 | lever                   | 7  | valve inlet connection |
| 2 | lever retaining pin     | 8  | seat                   |
| 3 | spindle                 | 9  | seat insert            |
| 4 | o-ring                  | 10 | seat closing spring    |
| 5 | gland nut               | 11 | poppet                 |
| 6 | valve outlet connection |    |                        |

**Figure 10 — Reverse seated valve (non-metallic seal, lever operated)**



**Key**

1	toggle	7	valve inlet connection
2	upper spindle	8	pressure relief device
3	packings	9	body seat
4	lower spindle	10	seat insert
5	valve outlet connection	11	pressure seal loading spring
6	pin index holes	12	gland nut

**Figure 11 — Pin-index (post-type medical) valve (non-metallic seal, toggle operated)**

## 5 Valve design requirements

### 5.1 General

Valves shall be designed to open and close and be leak tight from  $-20\text{ }^{\circ}\text{C}$  to  $+65\text{ }^{\circ}\text{C}$ . In the closed position, valves shall be leak tight during transport and storage (see test no. 8 in [Table 4](#)) for temperatures down to  $-40\text{ }^{\circ}\text{C}$ .

The design requirements given in [Clause 5](#) are minimum requirements to be met. The agreement of stricter requirements is permitted.

### 5.2 Materials

Under all intended operating conditions [see [6.3 f](#)], metallic and non-metallic materials in contact with the gas shall be chemically and physically compatible with the gas, either

- according to ISO 11114-1 and ISO 11114-2 or
- proven as being compatible, see [6.3 g](#)).

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

The compatibility of the lubricant(s) and adhesive(s), if used in gas wetted areas, shall also be considered.

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.

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 either:

- 1) a metallic material not showing a ductile to brittle transition (examples of materials not showing a ductile to brittle transition are copper alloys, austenitic stainless steels, aluminium alloys and nickel alloys), or
- 2) 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.

For valves requiring oxygen pressure surge testing (see 5.8), ignition resistance of non-metallic materials, lubricants and adhesives used in the gas wetted area of the valves should be considered (e.g. using an appropriate test procedure such as ISO 11114-3 for auto ignition temperature (AIT) testing and ISO 21010:2017, Annex C for oxygen pressure surge testing of materials using test apparatus as given in ISO 11114-6). Non-metallic materials used in oxygen wetted areas should have an AIT of at least 100 °C above its maximum service temperature tested at a pressure of at least 100 bar<sup>1)</sup> (see ISO 15001 or ASTM G63).

Lubricants used in all gas wetted areas of valves (e.g. for VIPR also the lubricants used downstream the pressure regulating system) for gases requiring oxygen pressure surge testing (see 5.8) shall either

- a) 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 21010:2017, Annex C.

- b) be permitted only if the corresponding valve passes the oxygen pressure surge test after being pre-conditioned via the endurance cycling procedure described in 6.13 but without subsequent leak tightness tests and without 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

If the valve connections are not an integral part of the valve body, the design shall ensure that they cannot be unintentionally disassembled.

Valve inlet and outlet connections shall conform to:

- an International Standard or
- regional or national standards or

---

1) 1 bar = 0,1 MPa = 10<sup>5</sup> Pa; 1 MPa = 1 N/mm<sup>2</sup>.

— proprietary designs that have been qualified to an acceptable industry standard.

If the valve outlet connection is also used as valve filling connection, the filling mechanism shall be designed so that it does not encroach or compromise safe gas withdrawal via user connectors in accordance with a relevant 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 407, ISO 5145 and ISO 10692-1. A partial compilation of regional and national standards is given in ISO/TR 7470. For medical VIPRs, see ISO 10524-3.

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.

Specific measures shall be taken if the valve filling connection is separated from the valve outlet connection in one of the ways given as a) and b).

- a) If the valve filling connection is located between the valve operating mechanism and the pressure receptacle [e.g. see [Figures 1 a\)](#), [2](#) and [3](#)], it shall be equipped with a filling connection closing device (i.e. non-return valve or isolating valve).
- b) If the valve filling connection is located between the valve operating mechanism and the valve outlet connection [e.g. see [Figure 1 b\)](#)], it shall be provided either with a filling connection closing device (i.e. non-return valve or isolating valve) or with a pressure-tight device (e.g. a plug or cap which can be operated or removed only by the use of a special proprietary tool provided by the manufacturer). If fitted, such a pressure-tight device shall be designed to vent gas before becoming disengaged.

If a non-return valve is used, it shall meet the requirements of [5.7](#) without replacement of the sealing system after 1 000 opening and closing cycles.

The endurance test of the filling connection non-return valve is given in [6.15](#).

If an isolating valve is used, it shall meet all requirements of [5.5](#), except that for the endurance test only 1 000 cycles shall be applied. Such isolating valves may be tested in combination with testing the valve operating mechanism.

NOTE 5 The reduction of the number of cycles to 1 000 cycles is based on the estimation that the filling connection is operated less frequently than the valve operating mechanism.

## 5.4 Mechanical strength

### 5.4.1 Resistance to hydraulic pressure

Valves shall withstand  $p_{vht}$  (see [6.7.1](#)) without burst.

The hydraulic pressure test is given in [6.9](#).

NOTE The hydraulic pressure test confirms whether the burst pressure of the valve is at least 1,5 times the test pressure of the pressure receptacle, which can be required by transport regulations (e.g. UN Model Regulations).

For valves for acetylene service see [5.5.4](#).

### 5.4.2 Resistance to mechanical impact

Valves shall withstand a mechanical impact, if:

- a) used for pressure receptacles not intended to be protected during transport by
  - a valve protection cap or a valve guard complying with ISO 11117, or
  - other suitable means;

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NOTE Applicable transport regulations normally specify the variety of suitable means to maintain the integrity of the pressure receptacle. For example, main valves used in bundles of cylinders according to ISO 10961 are protected by the frame.

- b) used for pressure receptacles where a valve guard is fixed only to the valve and not to the pressure receptacle. The valve shall be tested without the valve guard fitted.

Distortion due to impact is permissible. After being impacted, for safety reasons, the closed valve shall first be pressurized hydraulically to  $p_{vt}$  and not burst or leak. If successfully passed, the closed valve shall undergo a pneumatic leak tightness test at  $p_{vt}$  with the outlet unplugged.

The total leakage (comprising that from the valve internal sealing system plus that from the threaded joint between the valve and the pressure receptacle/test fixture) shall not exceed 100 cm<sup>3</sup>/h. Any leakage shall not result from cracking of the valve body. In addition, the test sample shall remain capable of being opened for emergency venting purposes by hand or by using a simple tool or actuating connector (e.g. a valve key) provided the opening torque, if relevant, does not exceed  $T_f$ , see [Table 1](#).

The impact test shall be in accordance with [Annex A](#).

### 5.4.3 Resistance to valve spindle impact for pin-index valves

If not permanently protected during transport and use, pin-index valves shall withstand a mechanical impact of its valve spindle without damage that can result in ejection of the valve spindle or any other valve components.

The valve spindle impact test is given in [6.17](#).

## 5.5 Valve operating mechanism

### 5.5.1 Opening and closing of the valve

The valve operating mechanism 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.

Valves for gases requiring oxygen pressure surge testing should have a slow opening characteristic curve to avoid rapid pressure surge. For manually operated valves this can be achieved by a design which requires more than one turn to reach full flow capacity. It can also be achieved using flow limiting devices.

### 5.5.2 Endurance

The valve operating mechanism shall meet the requirements of [5.7](#) without replacement of the sealing system after 2 000 opening and closing cycles.

For a VIPR type C with more than one valve operating mechanism (e.g. pressure outlet and flow selector), each valve operating mechanism shall be tested.

For valves where closure is achieved by applying a torque, the test shall be carried out using  $T_e$  according to [Table 1](#) at  $p_{vt}$  according to [6.7.2](#). For some valve designs,  $T_e$  is allowed to be increased during the given cycles. For compression packed gland seal valves, if needed, adjustment of the packing nut according to the manufacturer's specification is permitted.

The endurance test is given in [6.13](#).

It shall be possible to open and close the valve at pressures up to  $p_{vt}$  (see [6.7.2](#)) without using any additional equipment not recommended by the manufacturer. This shall be verified during the endurance test, see [6.13](#).

In addition, VIPR types B and C shall meet the requirements of [5.7](#) without replacement of the sealing system after 100 000 opening and closing cycles.

The additional endurance test of VIPR types B and C is given in [6.14](#).

After the endurance test(s) 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 places where they were installed), non-functional (e.g. broken) or missing.

The visual examination is given in [6.16](#).

### 5.5.3 Resistance to excessive torques

#### 5.5.3.1 All valves except VIPR type C with the flow selector acting as the primary valve operating mechanism and VIPR type B

Valves where closure is achieved by applying a torque shall withstand  $T_o$  and  $T_f$ , each applied in opening and closing directions using the values given in [Table 1](#).

Therefore, this requirement is, for example, not applicable to lever operated valves and actuator operated valves.

At  $T_o$ , the valve shall be able to work smoothly, without noticeable difficulties. It shall not show any damage or failure of any component(s) of the valve operating mechanism and/or valve operating device. This shall be checked by visual examination after dismantling the valve.

The value of  $T_f$  determined from applying a closing and an opening torque shall be not less than the value given in [Table 1](#) or in case of an intentional failure mode, the value specified by the manufacturer.

At  $T_f$ , the valve operating mechanism can be severely damaged and not operable. Mechanical failure shall occur prior to the valve operating mechanism unscrewing itself from the valve body and shall be in a manner that will not result in ejection of valve components. This shall be checked by visual examination or by hydraulically pressurizing the valve with  $p_{vt}$  if necessary.

**Table 1 — Torques to be used for the endurance test and excessive torque tests**

Valve design (e.g. as given in <a href="#">4.3</a> )	Valve seal/ seat	Valve operating device	Endurance torque	Over torque	Failure torque
			$T_e$ +10 % 0	$T_o$ ±5 %	$T_f$ min.
O-ring gland seal valve and pressure seal valve and reverse seated valve	Non-metallic	Handwheel diameter $D = 65$ mm	7 Nm	20 Nm	25 Nm
		Other handwheel diameters	$D \times 7/65$	$D \times 20/65$	$1,25 \times T_o$
		Key and toggle	$T_o/3$	$T_f / 1,25$	$T_f^a$
Diaphragm gland seal valve and compression packed gland seal valve	Non-metallic	Handwheel diameter $D = 65$ mm	$T_{e,start} = 7$ Nm $T_{e,end} \leq 10,5$ Nm	20 Nm	25 Nm
		Other handwheel diameters	$T_{e,start} = D \times 7/65$ $T_{e,end} \leq 1,5 \times T_{e,start} \leq 16$ Nm	$D \times 20/65$	$1,25 \times T_o$
		Key and toggle	$T_{e,start} = T_o/3$ $T_{e,end} \leq 1,5 \times T_{e,start}$	$T_f/1,25$	$T_f^a$

NOTE 1 Standard industry practice is to apply a 7 Nm closing torque on commonly used 65 mm handwheel diameter valves during operation.

NOTE 2 There is a general consensus that a nominal maximum torque of 16 Nm can be achieved by hand with a 65 mm handwheel diameter.

<sup>a</sup> The determination of  $T_f$  is given in [6.11.2](#).

Table 1 (continued)

Valve design (e.g. as given in 4.3)	Valve seal/ seat	Valve operating device	Endurance torque $T_e$ +10 0 %	Over torque $T_o$ ±5 %	Failure torque $T_f$ min.
O-ring gland seal valve and diaphragm gland seal valve and compression packed gland seal valve	Metal to metal	Handwheel diameter $D = 65 \text{ mm}$	$T_{e,start}$ to be specified by the manufacturer, but not less than $1,5 \times T_c$ and not less than 7 Nm $T_{e,end} \leq 1,5 \times T_{e,start} \leq 16 \text{ Nm}$	20 Nm	25 Nm
		Other handwheel diameters	$T_{e,start}$ to be specified by the manufacturer, but not less than $1,5 \times T_c$ and not less than $D \times 7/65$ $T_{e,end} \leq 1,5 \times T_{e,start} \leq D \times 16/65$	$D \times 20/65$	$1,25 \times T_o$
		Key and toggle	$T_{e,start} = T_c$ $T_{e,end} \leq T_o$	$T_f/1,25$	$T_f^a$
VIPR type C with the flow selector acting as primary valve operating mechanism and VIPR type B	Non-metallic	Handwheel	$T_o$ to be specified by the manufacturer but minimum $T_{ob}/2$	$T_{ob}$ (see 5.5.3.2)	Not applicable (see 5.5.3.2)

NOTE 1 Standard industry practice is to apply a 7 Nm closing torque on commonly used 65 mm handwheel diameter valves during operation.

NOTE 2 There is a general consensus that a nominal maximum torque of 16 Nm can be achieved by hand with a 65 mm handwheel diameter.

<sup>a</sup> The determination of  $T_f$  is given in 6.11.2.

If a valve design is not covered by Table 1, the valve manufacturer shall specify the torque values to be used for the tests and include them in the operating instructions [see 6.3 d)].

**5.5.3.2 VIPR type C with the flow selector acting as the primary valve operating mechanism and VIPR type B**

The manufacturer shall specify the over torque for a VIPR type B ( $T_{ob}$ ).  $T_{ob}$  shall not be less than 2 times the torque needed for regular operation of the valve operating device (e.g. flow selector for a VIPR type C with the flow selector acting as the primary valve operating mechanism). The design and size of the valve operating device should reflect this torque.

At  $T_{ob}$ , the valve shall not show any damage or failure of any component(s) of the valve operating mechanism (i.e. pressure regulating system) and/or valve operating device (e.g. flow selector for a VIPR type C with the flow selector acting as the primary valve operating mechanism) and/or stop mechanism for a VIPR type B. This shall be checked by visual examination after dismantling the valve.

Above  $T_{ob}$ , any failure shall not result in ejection of internal valve components. After failure it shall still be possible to open and close the valve using a simple tool. This shall be checked by visual examination or by hydraulically pressurizing the valve with  $p_{vt}$  if necessary.

The excessive torque tests are given in 6.11.

## 5.5.4 Acetylene specific requirements

### 5.5.4.1 General

For acetylene valves, the valve operating mechanism shall be designed to permit closure of the valve after exposure to an acetylene flashback and subsequent decomposition within the cylinder. This general requirement is considered to be fulfilled if the specific tests referenced in [5.5.4.2](#) to [5.5.4.4](#) are passed.

### 5.5.4.2 Acetylene valves except main valves and VIPRs

Acetylene valves except main valves and VIPRs shall withstand 909 bar without permanent visible deformation or burst (rupture).

The acetylene hydraulic pressure test is given in [Annex B, B.1](#).

In case of soft seal valve designs with the soft seal removed (e.g. as result of an acetylene flashback), the leakage rate shall not exceed 50 cm<sup>3</sup>/h.

The acetylene seat leak tightness test is given in [Annex B, B.2](#).

### 5.5.4.3 Acetylene main valves

Acetylene main valves shall undergo an acetylene decomposition test as a stop valve in accordance with ISO 15615:2022, Table A.1 via the outlet connection in both open and closed positions.

After the decomposition test in the closed position, the valves shall be tested for internal tightness. The leakage rate shall not exceed a maximum of 50 cm<sup>3</sup>/h.

After carrying out these tests, those given in [Annex B](#) are not required.

NOTE It is assumed that mechanical strength (as addressed in [Annex B, B.1](#)) is already validated by the acetylene decomposition test given in ISO 15615:2022. The internal leak tightness test after decomposition replaces the seat leak tightness test given in [Annex B, B.2](#).

### 5.5.4.4 Acetylene VIPRs

In case of soft seal valve designs with the soft seal removed (e.g. as result of an acetylene flashback), the leakage rate shall not exceed 50 cm<sup>3</sup>/h.

The acetylene seat leak tightness test is given in [Annex B, B.2](#).

All acetylene VIPRs shall withstand acetylene decomposition without permanent visual deformation or rupture. No flame shall exit the VIPR. No part shall be ejected. A destruction of inner parts is permitted.

The acetylene decomposition test for VIPRs is given in [Annex B, B.3](#).

NOTE It is assumed that mechanical strength (as addressed in [Annex B, B.1](#)) is already validated by the acetylene decomposition test given in [Annex B, B.3](#).

## 5.6 Valve operating device

### 5.6.1 Closing direction

If the valve operating device closes the valve by rotation, this shall be in a clockwise direction.

Only for certain VIPR designs where a combination (isolation and flow selection) valve design is used, the valve operating device may be closed anti-clockwise. For these designs, the closing and/or opening direction shall be clearly marked.

For all other valve designs, the direction of opening and/or closing should be clearly marked.

### 5.6.2 Handwheel diameter

Except for VIPR type B, if a handwheel is used,  $D$  shall be chosen such that  $T_c$  can be achieved. This shall be verified using [Formula \(1\)](#).

$$D \geq \frac{T_c \times 65}{7} \quad (1)$$

### 5.6.3 Exposure to flame

#### 5.6.3.1 Manually operated valves

For manually operated valves, other than key operated valves, the valve operating device shall be designed to permit the closure of the valve after exposure to a flame. Although the valve operating device can be damaged during the test, a manually operated valve shall still be possible to be closed by hand or using a simple tool after the flame has extinguished and it has cooled naturally.

For key operated valves, the drive interface shall be designed to permit the closure of the valve after exposure to a flame.

The flame impingement test is given in [6.10](#).

#### 5.6.3.2 Actuator operated valves

For actuator operated valves, it shall be verified that, after the connection between the valve operating device and the valve operating mechanism being exposed to a flame and the flame has extinguished, either the valve operating mechanism is still functioning (open/close) or that the valve is in the closed position.

The flame impingement test is given in [6.10](#).

## 5.7 Leakage

Unless otherwise stated, the leakage rates given in [Table 2](#) shall be applied over the range of pressures and temperatures specified in [Table 4](#) and [Table 7](#).

**Table 2 — Leakage rates for leak tightness tests**

Valve type	Maximum leakage rate for leak tightness test in transport and storage conditions at -40°C		Maximum leakage rate for internal leak tightness test	Maximum leakage rate for external leak tightness test
	Designs with pressure retaining components located upstream of the valve seat <sup>a</sup>	Designs without pressure retaining components located upstream of the valve seat		
Valve, except VIPR	12 cm <sup>3</sup> /h	6 cm <sup>3</sup> /h	6 cm <sup>3</sup> /h	6 cm <sup>3</sup> /h
VIPR	12 cm <sup>3</sup> /h	6 cm <sup>3</sup> /h	6 cm <sup>3</sup> /h <sup>b</sup>	12 cm <sup>3</sup> /h
NOTE The leakage of 6 cm <sup>3</sup> /h is approximately 4 bubbles of 3,5 mm diameter per minute.				
<sup>a</sup> The higher leak rate is due to the fact that the sealing performance of the components located upstream of the valve seat can be affected by the low temperature.				
<sup>b</sup> For all leak tightness tests after the endurance test of VIPR types B and C designs as given in <a href="#">6.14</a> (test no. 6 of <a href="#">Table 4</a> ), 12 cm <sup>3</sup> /h apply.				

For the leak tightness test of a pressure relief valve located upstream of the valve operating mechanism (test no. 14 in [Table 4](#)), a maximum leakage rate of 6 cm<sup>3</sup>/h applies.

The leak tightness tests are given in [6.12](#) and, if applicable in [6.18](#) (additional test for valves with a pressure relief valve located upstream of the valve operating mechanism).

## 5.8 Resistance to ignition

To verify the 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) requiring 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 test pressures of the pressure receptacle given in Packing Instruction P 200 of the UN Model Regulations.

- c) gas mixtures, which are not pre-mixed, 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 for natural air, pre-mixed synthetic air and pre-mixed mixtures containing oxygen or other oxidizing gases with a total oxidizing partial pressure up to 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 leakage of the valve is observed (e.g. audible sound, pressure drop) during oxygen 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, 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 can be necessary to compare the tested sample with a non-oxygen tested sample from the other type tests.

The oxygen pressure surge test for all valves covered by this document is given in [Annex C](#).

## 5.9 Flow capacity

Valve charging and discharging rates and evacuation times are affected by the flow capacity of the valve. Unless otherwise specified, valves, except VIPRs, should have valve flow coefficients ( $c_v$ ) as shown for each valve category in [Table 3](#).

**Table 3 – Recommended valve flow coefficients**

Valve category	Minimum valve flow coefficient $c_v$
Valves for small cylinders up to 1,8 l <sup>a</sup>	0,07
Valves for cylinders containing up to 1,13 m <sup>3</sup> acetylene <sup>a</sup>	0,07
Pin-index valves	0,1
General purpose valves	0,35
Carbon dioxide valves	0,7
Special purpose valves	As required
Residual pressure valves	0,2

<sup>a</sup> Values are taken from CGA V-9 and are therefore representing commonly used North American cylinder sizes.

An example of how to determine the valve flow coefficient is given in CGA V-9.

## 6 Type testing

### 6.1 General

Tests and examinations performed to demonstrate compliance with this document shall be conducted using instruments calibrated before being put into service and thereafter according to an established programme. A type test is valid for a given valve design (see [4.3](#)).

The test parameters (e.g. number of test samples, number of endurance cycles, number of oxygen pressure surge shocks, test temperatures, leakage rate) in [Clause 6](#) are minimum requirements to be met. The agreement of stricter test parameters is permitted.

### 6.2 Test schedule

To comply with this document, valves shall be type tested in accordance with the schedule given in [Table 4](#).

The hydraulic pressure test shall always be carried out as the first test. The sequence of all other tests is not mandated to be in the order listed unless otherwise stated in column "Condition of test sample" of [Table 4](#). As specified in [5.3](#), filling connection isolating valves may be tested in combination with testing the primary valve operating mechanism.

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Table 4 — Test schedule for type testing (valve design without material variants)

Test no.	Applicability	Test and relevant subclause	Condition of test sample	Test temperature °C	Test pressure bar	Quantity of test samples <sup>b</sup>
1	All valves, except for acetylene service, see 5.5.4	Hydraulic pressure test, 6.9	As received	Room temperature <sup>a</sup>	$p_{vht}$	1
2	All valves	Flame impingement test, 6.10	As received or from test 1 <sup>d</sup>	Room temperature <sup>a</sup>	—	1
3	Valves where closure is achieved by applying a torque, see 5.5.3	Excessive torque tests, 6.11	As received	Room temperature <sup>a</sup>	—	4
4	All valves	Internal/external leak tightness tests, 6.12	As received	Room temperature <sup>a</sup>	See Table 7	5
5	All valves	Endurance test, 6.13	From test 4	Room temperature <sup>a</sup>	$p_{vt}$	5
6	VIPR types B and C, see 5.5.2	Endurance test of VIPR types B and C, 6.14	From test 5 and subsequent aging at (65±2,5) °C for 5 days	Room temperature <sup>a</sup>	See 6.14	3
7	Valves with a separated valve filling connection, fitted with a non-return valve	Endurance test of the filling connection non-return valve, 6.15	As received or from test 5 or from test 6 <sup>e</sup>	Room temperature <sup>a</sup>	$p_{vt}$	3 <sup>g</sup>
8	All valves	Leak tightness test in transport and storage conditions, 6.12.2.3	From test 5 or from test 5 and test 6 or from test 5 and test 7 or from tests 5, 6 and 7	0 -40 -5	$p_{vt}$	5 or 8 <sup>f,h</sup>
9	All valves	Internal/external leak tightness tests, 6.12	From test 8	0 -20 -5	See Table 7	5 or 8 <sup>f,i</sup>
10	All valves	Internal/external leak tightness tests, 6.12	From test 9	65 <sup>+2,5</sup> -2,5	See Table 7	5 or 8 <sup>f,i</sup>
11	All valves	Internal/external leak tightness tests, 6.12	From test 10	Room temperature <sup>a</sup>	See Table 7	5 or 8 <sup>f,i</sup>
12	All valves	Visual examination, 6.16	From test 11	Room temperature <sup>a</sup>	—	5 or 8 <sup>f</sup>

<sup>a</sup> Typically between 15 °C and 30 °C.

<sup>b</sup> For additional material variants, test sample numbers and number of tests will change (in accordance with Annex F).

<sup>c</sup> For metal-to-metal sealing valve designs this test need not be carried out, see Clause B.2.

<sup>d</sup> By agreement between the manufacturer and the test laboratory, it is permitted to use the test sample from test no. 1.

<sup>e</sup> By agreement between the manufacturer and the test laboratory, it is permitted to use new test samples (as received).

<sup>f</sup> If test no. 7 was carried out with new test samples (as received), these test samples shall be tested additionally which will result in a total quantity of eight test samples.

<sup>g</sup> The test samples may be taken from the test samples of the previous test, if applicable.

<sup>h</sup> For valves with a filling connection non-return valve located downstream of the valve operating device and which was endurance tested according to test no. 7 with new test samples (as received), this test needs not to be carried out.

<sup>i</sup> For valves with a filling connection non-return valve located downstream of the valve operating device and which was endurance tested according to test no. 7 with new test samples (as received), the internal leakage test need not to be carried out.

Table 4 (continued)

Test no.	Applicability	Test and relevant subclause	Condition of test sample	Test temperature °C	Test pressure bar	Quantity of test samples <sup>b</sup>
13	Pin-index valves	Valve spindle impact test for pin-index valves, <a href="#">6.17</a>	As received	Room temperature <sup>a</sup>	—	3
14	Valves fitted a pressure relief valve located upstream of the valve operating mechanism	Pressure relief valve tightness test, <a href="#">6.18</a>	As received	See <a href="#">6.18</a>	See <a href="#">6.18</a>	3
15	See <a href="#">5.4.2</a>	Impact test, see <a href="#">Annex A</a>	As received	Room temperature <sup>a</sup>	$p_{vt}$	1
16	For acetylene service (except main valves and VIPRs), see <a href="#">5.5.4</a>	Acetylene hydraulic pressure test, <a href="#">Clause B.1</a>	As received	Room temperature <sup>a</sup>	909	3
17	For acetylene service (except main valves), see <a href="#">5.5.4</a>	Acetylene seat leak tightness test, <a href="#">Clause B.2</a>	As received (without soft seal)	Room temperature <sup>a</sup>	$p_{vt}$	3
18	VIPRs for acetylene service, see <a href="#">5.5.4</a>	Acetylene decomposition test of VIPR designs, <a href="#">Clause B.3</a>	As received	See <a href="#">Clause B.3</a>	25 bar	3
19	Main valves for acetylene service, see <a href="#">5.5.4</a>	Acetylene decomposition test, ISO 15615:2022, 6.7	As received	See ISO 15615:2022, 6.7	25 bar	6
20	For oxygen service, see <a href="#">5.8</a>	Oxygen pressure surge test, see <a href="#">Annex C</a>	For all valves with lubricants rated for valve test pressure, see <a href="#">5.2 a</a> ): As received. For all valves with lubricants not rated for valve test pressure, see <a href="#">5.2 b</a> ): Pre-conditioned via endurance cycling procedure (test no. 5).	In accordance with <a href="#">Annex C</a>	$p_{vt}$	3

<sup>a</sup> Typically between 15 °C and 30 °C.

<sup>b</sup> For additional material variants, test sample numbers and number of tests will change (in accordance with [Annex F](#)).

<sup>c</sup> For metal-to-metal sealing valve designs this test need not be carried out, see [Clause B.2](#).

<sup>d</sup> By agreement between the manufacturer and the test laboratory, it is permitted to use the test sample from test no. 1.

<sup>e</sup> By agreement between the manufacturer and the test laboratory, it is permitted to use new test samples (as received).

<sup>f</sup> If test no. 7 was carried out with new test samples (as received), these test samples shall be tested additionally which will result in a total quantity of eight test samples.

<sup>g</sup> The test samples may be taken from the test samples of the previous test, if applicable.

<sup>h</sup> For valves with a filling connection non-return valve located downstream of the valve operating device and which was endurance tested according to test no. 7 with new test samples (as received), this test needs not to be carried out.

<sup>i</sup> For valves with a filling connection non-return valve located downstream of the valve operating device and which was endurance tested according to test no. 7 with new test samples (as received), the internal leakage test need not to be carried out.

[Annex F](#) specifies which tests shall be repeated to validate changes and/or material variants within a valve design.

### 6.3 Documentation

The manufacturer shall make available to the test laboratory, if applicable:

- 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 comply with 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 with sufficient detail to specify the VIPR or RPV filling connector used for the oxygen pressure surge test. This information may also be submitted by a third party.
- c) Information on markings.
- d) A description of the valve and method of operation as well as minimum closing torque ( $T_c$ ), specified torque to be applied for the endurance torque at start test ( $T_{e,start}$ ) and, if applicable the intentional failure mode and torque ( $T_f$ ) or the over torque for VIPR type B ( $T_{ob}$ ) for the excessive torque tests.
- e) For compression packed gland seal valves, instruction about adjustment of the packing nut in case of external leakage.
- f) Information on operating conditions (gases and gas mixtures, valve working or valve test pressure, service temperatures if outside of the normal temperature range (see [5.1](#)), use with or without valve protection, etc.).
  - 1) If the valve is intended to be used without valve protection, the maximum total package mass shall be defined.
  - 2) It shall be clearly indicated which gases and gas mixtures can be used with each valve material variant.
- g) Proof of material compatibility, if not covered by ISO 11114-1 or ISO 11114-2.

### 6.4 Test samples

The test samples shall be in the condition that the manufacturer intends to supply to the customer. However, items that do not have any influence on specific individual test requirements may be omitted, for example, aesthetic covers, pressure-tight outlet cap and valve guard.

For valves designed to incorporate pressure relief devices, their ports shall be plugged or sealed. If a plug is used, it shall replicate the pressure relief device sealing geometry.

For valves designed to incorporate a pressure relief valve upstream of the valve operating mechanism, the test samples for test no. XX in [Table 4](#), as described in [6.18](#), shall be submitted with the pressure relief valve fitted. In case the pressure relief valve design is intended to be used for different nominal set pressures, the highest of these settings shall be provided.

Valves designed to incorporate pressure gauges or pressure indicators shall have these devices fitted during impact, oxygen pressure surge and acetylene decomposition testing. For all other tests, pressure gauges or pressure indicators may be replaced by a plug. If a plug is used, it shall replicate the pressure gauge or pressure indicator sealing geometry.

The number of test samples for testing a valve design is given in [Table 4](#). Additional test samples can be required for changes or for material variants within the valve design in accordance with the requirements of [Annex F](#).

For a valve designed to incorporate a RPD or a non-return valve, if the device prevents detection of internal leakage, either a tool shall be provided to neutralize the device or the test samples for the endurance test

shall be supplied with the device neutralized or removed. Test samples for oxygen pressure surge testing to be pre-conditioned via the endurance test procedure as required by 5.8, shall have the RPD fitted without being neutralized.

If oxygen pressure surge testing of a VIPR or a RPV is required (see 5.8), the test samples shall be supplied with the corresponding filling connector.

After being tested, the test samples shall be rendered unserviceable or shall be clearly marked as test samples to avoid entering into service.

## 6.5 Test report

A written report referencing this document including its year of publication (i.e. ISO 10297:2024) shall be issued. It shall include the test sample(s) identification and the date/period of the test and shall additionally summarize the tests carried out, the test parameters used, the results obtained, any unusual features observed and shall include or reference the documentation listed in 6.3 and, if applicable:

- a)  $T_c$  as determined;
- b)  $T_{e,start}$  and  $T_{e,end}$ ;
- c) if applicable, intentional failure mode and corresponding  $T_f$ ;
- d) for compression packed gland seal valves, number of adjustments of the packing nut during endurance and tightness testing;
- e) information on the applied installation torque during impact test and number of threads not engaged in the pressure receptacle neck or test fixture, if any;
- f) vacuum conditions, as applied;
- g) all relevant data for valve designs not covered by Table 1;
- h) technical justification for reduction of test samples as permitted where applicable in 3<sup>rd</sup> and 10<sup>th</sup> line of Table F.1;
- i) for valves oxygen pressure surge tested, all relevant data required by ISO 11114-6 and drawings or other documentation with sufficient detail to specify the valve inlet connection blind plug.

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

## 6.6 Test temperatures

The test temperatures are given in Table 4.

## 6.7 Test pressures

### 6.7.1 Valve hydraulic test pressure

For compressed gases,  $p_{vht}$  is given by Formula (2):

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

For liquefied gases  $p_{vht}$  is given by Formula (3):

$$p_{vht} = 1,5 \times p_{vt} \quad (3)$$

### 6.7.2 Valve test pressure

Testing shall be conducted at  $p_{vt}$  as given in Table 5.

Table 5 — Valve test pressures

Gas	$p_{vt}$ bar
Fluorine Oxygen difluoride	160
Nitric oxide	180
All other compressed gases	$1,2 \times p_w$
Liquefied gases	At least equal to the minimum test pressure of the pressure receptacle for that gas or gas group <sup>a</sup>
Acetylene and other dissolved gases	At least equal to the minimum test pressure of the pressure receptacle for that gas or gas group <sup>a</sup>
NOTE Transport regulations can require the valve test pressure to correspond with the valve outlet connection pressure rating.	
<sup>a</sup> Minimum values can be found in the relevant transport regulation. Where a minimum test pressure is not specified, the test pressure marked on the pressure receptacle for which the valve is intended shall be used or the manufacturer shall specify $p_{vt}$ .	

$P_{vt}$  for extinguishing agents charged with compressed gases shall be at least the developed pressure of the filled pressure receptacle at 65 °C. The developed pressure at 65 °C shall be calculated depending on the compressed gas and its maximum filling pressure at a given filling temperature as well as maximum filling ratio. The vapour pressures and volumetric expansion of all substances in the pressure receptacle shall be taken into account.

NOTE 1 Liquid phase expansion coefficients and vapour pressures are, for example, available from NIST databases<sup>2)</sup> or from fire-extinguishing agents manufacturer's data sheets.

NOTE 2 The calculation method is given in packing instructions P 200 and P 206 of the UN Model Regulations.

If available, experimental data for the developed pressure at 65 °C taking the solubility of the compressed gas into account may be used instead of calculated data.

NOTE 3 For experimental data, see for example, the ISO 14520 series.

If the filling conditions are not known, the manufacturer shall specify  $p_{vt}$ .

## 6.8 Test gases

### 6.8.1 Gas quality

Gas quality shall correspond to [Table 6](#).

2) NIST = National Institute of Standards and Technology, USA, [www.nist.gov](http://www.nist.gov).

Table 6 — Gas quality

Parameter	Oxygen	All other gases (including air)
Dew point ≤ -40 °C at atmospheric pressure <sup>a</sup>	Yes	Yes
Oil content ≤ 0,1 mg/m <sup>3</sup> <sup>a</sup>	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
NOTE Standard industrial gases normally meet the requirements of this table.		
<sup>a</sup> These values are identical to Class 2 requirements in ISO 8573-1:2010.		

### 6.8.2 Leak tightness tests

In general, the leak tightness tests should be carried out with air or nitrogen. Helium, hydrogen or inert mixtures of these gases may be used alternatively if agreed between the manufacturer and the test laboratory. For valves for helium, hydrogen or their mixtures, the test gas for the tightness tests after the endurance test shall be a choice of helium, hydrogen or a non-flammable mixture of these gases.

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

### 6.8.3 Endurance tests

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

### 6.8.4 Acetylene decomposition test

The acetylene decomposition test shall be carried out with acetylene.

### 6.8.5 Oxygen pressure surge test

The oxygen pressure surge test shall be carried out with oxygen. Requirements on oxygen quality are given in ISO 11114-6.

## 6.9 Hydraulic pressure test

Valves for acetylene service, except main valves and VIPRs, shall be tested in accordance with [Annex B, B.1](#).

For a VIPR, this test does not cover the low-pressure chamber.

NOTE The hydraulic pressure test for the low-pressure chamber of a VIPR is given in ISO 22435 or ISO 10524-3, respectively.

The hydraulic pressure test shall be carried out with the valve in the open position (valve outlet/filling connection(s) plugged and for a VIPR the pressure regulator valve closed or held in the closed position). Actuator operated valves shall be opened according to the manufacturer's specification.

Except for actuator operated valves, the test shall be repeated with the valve in the closed position (valve outlet/filling connection(s) and for a VIPR also the pressure regulator valve closed or held in the closed position).

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  $p_{vht}$  is reached. The pressure shall be maintained by hydraulic pump (if necessary) for at least 1 min.

## 6.10 Flame impingement test

The test sample in the open position shall be exposed for  $60^{+5}_0$  s to a LPG blowpipe flame of approximately 150 mm length, such that the flame reaches a typical temperature of between 800 °C and 1 000 °C. The test procedure to be used is design dependent. The possible procedures are:

- a) for manually operated valves other than key operated valves, the valve operating device shall be exposed and completely enveloped by the flame;
- b) for key operated valves, the drive interface shall be exposed and completely enveloped by the flame;
- c) for actuator operated valves, the connection between the valve operating device and the valve operating mechanism shall be exposed and completely enveloped by the flame.

## 6.11 Excessive torque tests

### 6.11.1 Handwheel operated valves

For handwheel operated valves, if the valve is designed for an intentional failure mode at  $T_f$ , for example, handwheel or spindle failure to occur at a value less than the value given in [Table 1](#), the manufacturer shall specify the intentional failure mode and estimated  $T_f$ . The test samples shall be tested at this stated value and the failure mode shall be confirmed.

For handwheel operated valves, a closing torque on one test sample shall gradually be increased to  $T_0$  according to [Table 1](#).

To determine  $T_f$ , a closing torque on a different test sample than used for the determination of  $T_0$  shall gradually be increased until failure of any part of the valve operating mechanism or valve operating device occurs.

The determination of  $T_0$  and  $T_f$  shall then be repeated on two other test samples under the same conditions but applying an opening torque instead of a closing torque.

### 6.11.2 Key and toggle operated valves

For key operated valves, if the key is not integrated into the valve as part of its operating device, the tests may be carried out with a torque wrench.

For toggle operated valves, the toggle shall be fitted to the valve during testing.

For key and toggle operated valves,  $T_f$  first shall be determined using two test samples.

To determine  $T_f$ , a closing torque on one test sample and an opening torque on a second test sample shall gradually be increased slowly until failure of any part of the valve operating mechanism or operating device occurs.

Then,  $T_0$  shall be calculated on the basis of the lowest of these two failure torque values using the formula given in [Table 1](#). This value of  $T_0$  shall be applied on two other test samples then used for the determination of  $T_f$ .

### 6.11.3 VIPR type C with the flow selector acting as the primary valve operating mechanism and VIPR type B

A closing torque on one test sample shall gradually be increased to  $T_{ob}$ .

A closing torque on a different test sample than used for the application of  $T_{ob}$  shall gradually be increased until failure of any part of the valve operating mechanism or valve operating device or stop mechanism for a VIPR type B occurs.

This test shall then be repeated on two other test samples under the same conditions but applying an opening torque instead of a closing torque.

## 6.12 Leak tightness tests

### 6.12.1 General

Each internal and external leak tightness test temperature sequence (see [Table 4](#)) shall comprise the test pressures as given in [Table 7](#) in increasing order for room and high temperature tests and decreasing order for  $-20\text{ °C}$  test.

NOTE This order was chosen to reflect normal pressure receptacle operations.

**Table 7 — Pressures for leak tightness tests**

Condition	Pressure to be applied bar
If required by the manufacturer (based on application). An example of a vacuum test is given in <a href="#">Annex D</a> .	Vacuum
Mandatory	$0,5 \pm 0,1$
Mandatory	$10 \pm 0,3$
Mandatory	$p_{vt}$ (see <a href="#">6.7.2</a> )

Prior to the test, the valves shall achieve the relevant test temperature as given in [Table 4](#) 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.

### 6.12.2 Internal leak tightness test

#### 6.12.2.1 General

Except for a VIPR type B,  $T_c$  shall be specified by the manufacturer and shall be verified by the test laboratory during the first leak tightness test (test no. 4 of [Table 4](#)).

#### 6.12.2.2 Test at room and high temperature

The test shall be carried out in the following order:

- a) Seal valve outlet connection(s). For valves with a separated valve filling connection which is equipped with an isolating valve, it shall be decided on a case by case basis, if that isolation valve shall be open or closed during testing.
- b) Open the valve.
- c) The pressure shall be applied to the valve inlet and be raised until the appropriate pressure as specified in [Table 7](#) is reached.
- d) Close the valve to the closing position. The closing torque for manually operated valves for the leak tightness test carried out before the endurance test shall be  $T_c$ . The closing torque for manually operated valves required to achieve tightness for the leak tightness test carried out after the endurance test shall not be greater than  $T_{e,end}$ , including the given tolerance, according to [Table 1](#).

- e) Open the valve outlet connection. If the valve incorporates a RPD and/or a non-return valve, connect the tool or the filling adapter supplied by the manufacturer.
- f) Wait at least 1 min before measuring the seat leakage rate.

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

This test sequence shall be repeated for each pressure given in [Table 7](#). Before applying the next test pressure, it is allowed to vent the valve.

### 6.12.2.3 Test at low temperatures

The test shall be carried out in the following order:

- a) Seal valve outlet connection(s). For valves with a separated valve filling connection which is equipped with an isolating valve, it has to be decided on a case by case basis, if that isolation valve shall be open or closed during testing.
- b) Open the valve.
- c) The pressure shall be applied to the valve inlet and be raised until the appropriate pressure as specified in [Table 7](#) is reached.
- d) Close the valve to the closing torque. For manually operated valves, the closing torque required to achieve tightness shall not exceed  $T_{e,end}$ , including the given tolerance, according to [Table 1](#). For the test for leak tightness in transport and storage conditions, the valve shall be closed at room temperature before being cooled down [see f)].
- e) Open the valve outlet connection. If the valve incorporates a RPD and/or a non-return valve, connect the tool or the filling adapter supplied by the manufacturer.
- f) For the test for leak tightness in transport and storage conditions, 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.
- g) Wait at least 1 min before measuring the leakage rate.

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

This test sequence shall be repeated for each pressure given in [Table 7](#) except for the test for leak tightness in transport and storage conditions where only  $p_{vt}$  is required. Before applying the next pressure, it is allowed to vent the valve. To carry out the tests at  $-20\text{ °C}$ , it is only necessary to raise the temperature without passing through room temperature.

### 6.12.3 External leak tightness test

For compression packed gland seal valves, adjustment of the packing nut according to the manufacturer's specification is permitted during external leak tightness testing.

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 valve inlet connection. For valves with a separated valve filling connection, this connection shall remain unplugged.
- b) Open all valve operating mechanisms.
- c) The pressure shall be applied to the valve inlet connection and be raised until the appropriate pressure as specified in [Table 7](#) is reached.
- d) Wait at least 1 min before measuring the total leakage rate.

In addition, for manually operated valves, except for diaphragm gland seal valves, the leakage rate shall be determined with the valve operating mechanism in two intermediate positions (e.g. approximately 2/3 and 1/3 of the 'fully open' position). Additional positions shall be investigated if any leakage is detected during operation of the valve operating device. This test sequence shall be repeated for each pressure given in [Table 7](#). Before applying the next pressure, it is allowed to vent the valve.

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

### 6.13 Endurance test

An endurance test of 2 000 cycles (opening and closing) shall be carried out using  $T_e$  as given in [Table 1](#) at  $p_{vt}$ . The valve inlet shall remain pressurized to  $p_{vt}$  throughout the entire test. The valve outlet shall be connected to a venting device that remains closed during the closing and opening portions of the cycle. After each closure, by opening the venting device, the pressure downstream of the valve seat shall be released to atmosphere to reach atmospheric pressure.

For handwheel operated valves, the valve shall be operated by the handwheel. Some valve designs require special operation of the handwheel to engage with the valve operating mechanism, e.g. valves with handwheels that incorporate a push to turn locking mechanism. With such valves, it is permissible to override this mechanism or to carry out the endurance test manually.

For key operated valves, the valve shall be tested without the key fitted.

For toggle operated valves, the valve shall be tested with the toggle fitted on at least three of the five test samples.

For lever operated valves, the test shall be carried out by operating the lever through its full travel from closed to open.

For actuator operated valves, the test shall be conducted according to the manufacturer's specification, e.g. actuation pressure, voltage supplies.

For a VIPR, the pressure regulating system shall be in the setting which allows maximum gas flow through the regulator seat when the VIPR will be vented. For VIPR type C designs where the primary valve operating mechanism is not protected by a pressure relief valve on its upstream side, the pressure regulating mechanism shall be neutralized in a fully open condition to allow  $p_{vt}$  on the upstream side of the primary valve operating mechanism.

For specific VIPR designs (e.g. a VIPR type C with more than one valve operating mechanism, see [5.5.2](#)), endurance torque (if applicable) and test procedure shall be decided on a case by case basis and agreed between the manufacturer and the test laboratory.

$T_e$  and the leakage (by pressure drop) shall be checked immediately before commencing every cycle. If the pressure drop due to the valve leaking externally is greater than 10 bar, the valve has failed the test.

For specific valve designs as given in [Table 1](#), it is permitted to increase  $T_e$  during the test when the internal tightness is no longer achieved. For those designs, if the pressure measured at the high pressure transducer (key no. 4 of [Figure E.1](#)) after having vented the outlet is more than 5 bar,  $T_e$  shall be increased by nominal 10 % of the allowed torque range (range between  $T_e$  and  $T_{e,end}$ ) or 0,5 Nm (whichever is the higher value) but in any case shall not be higher than  $T_{e,end}$ .

After each closure, by opening the venting device, the pressure downstream of the valve seat shall be released to atmosphere to reach atmospheric pressure.

The test equipment shall meet the requirements given in [Annex E](#) except if the test is carried out manually. The manufacturer may specify a speed within the range given in [E.2.1](#).

There shall be a pause between 3 s to 12 s at each open and fully closed position. The manufacturer may specify a pause within this allowed range. Under exceptional circumstances due to temperature rise, this pause may be extended by agreement between the manufacturer and test laboratory.

### 6.14 Endurance test of VIPR types B and C

The VIPR shall be subjected to 100 000 endurance test cycles. The manufacturer may specify a reduced number of cycles for pressure regulating systems with metallic diaphragms or metallic bellows, but the number of cycles shall in any case not be less than 10 000 cycles. This reduction may only be done by reducing the number of cycles in sequence g) of this subclause.

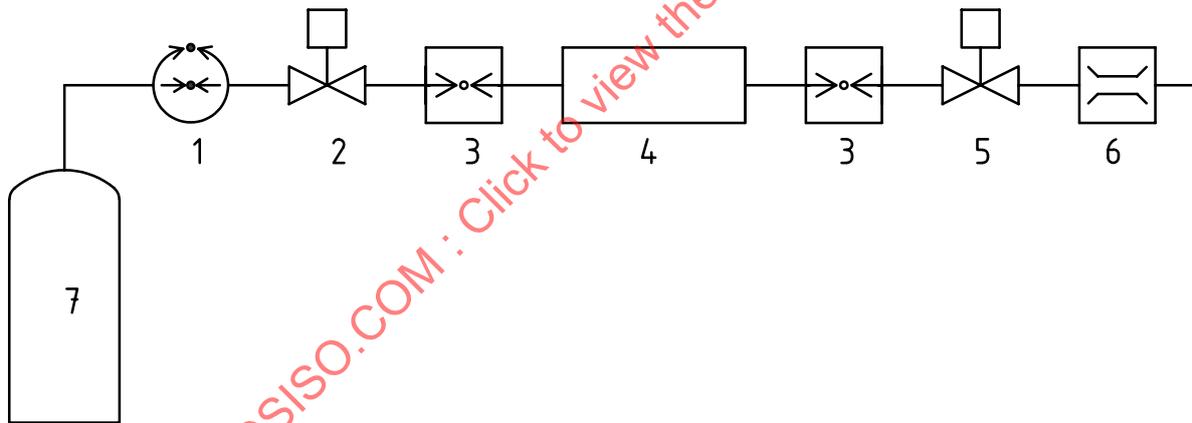
For this test, the VIPR shall be installed so that the valve inlet connection is connected to a source of test gas at a minimum pressure of 80 % of  $p_1$ ,  $p_1$  being the inlet pressure to the pressure regulating system. The value of  $p_1$  is gas-specific as follows:

- for compressed gases:  $p_1 = p_w$
- for acetylene:  $p_1 = 25$  bar
- for carbon dioxide:  $p_1 = 200$  bar
- for other gases:  $p_1$  shall be specified by the manufacturer.

If the VIPR is fitted with a pressure outlet (even if a flow selector is present), the test shall be carried out through the pressure outlet. The outlet pressure shall be set at  $p_2$ , with  $p_2$  being the nominal outlet pressure as specified by the manufacturer.

If the VIPR is only fitted with a flow selector, the outlet flow shall be set at  $Q_n$ , with  $Q_n$  being the nominal discharge to be specified by the manufacturer.

The test apparatus shall incorporate valves upstream and downstream of the VIPR test sample to permit introduction and venting of the test gas. An example of a test apparatus set-up is given in [Figure 12](#).



**Key**

- |   |                         |   |                           |
|---|-------------------------|---|---------------------------|
| 1 | pressure regulator      | 5 | downstream shut-off valve |
| 2 | upstream shut-off valve | 6 | flow metering valve       |
| 3 | pressure gauge          | 7 | gas supply                |
| 4 | test sample             |   |                           |

**Figure 12 — Example of a test apparatus set-up for endurance test of a VIPR type B**

The VIPR shall be aged at  $(65 \pm 2,5)$  °C for five days.

The VIPR shall then be subjected to the following sequence:

- a) with a downstream shut-off valve in the closed position, pressurize to a minimum pressure of 80 % of  $p_1$  through the valve inlet connection with the upstream shut-off valve open;
- b) open the downstream shut-off valve and allow the gas to release for a duration between 3 s and 12 s (to be specified by the manufacturer);

- c) close the downstream shut-off valve to stop the flow for a duration between 3 s and 12 s (to be specified by the manufacturer);
- d) repeat b) to c) 100 times;
- e) close the upstream shut-off valve;
- f) open the downstream shut-off valve to depressurize the complete VIPR;
- g) repeat a) to f) 1 000 times.

## 6.15 Endurance test of the filling connection non-return valve

### 6.15.1 Filling connection non-return valve downstream of the valve operating mechanism

The test shall be carried out in the following order:

- a) With the valve operating mechanism in the open position, connect a filling connector device with a retractable pin to the valve filling connection. The parameters of the retractable pin (diameter and stroke) shall be agreed between the manufacturer and the test laboratory.
- b) Mechanically open the filling connection non-return valve using the retractable pin of the filling connector device so that it is in the intended filling position, i.e. replicating the stroke of the non-return valve.
- c) Pressurize the test sample from the valve filling connection to  $p_{vt}$  and maintain  $p_{vt}$  with no flow for at least 2 s after the gas pressure has stabilized.
- d) Shut off the gas supply.
- e) De-pressurize the filling connection from the filling port side vent valve.
- f) Retract the pin in the filling connector device in order to allow the filling connection non-return valve to return to the closed position.
- g) Pressurize the test sample from the valve inlet connection to  $p_{vt}$  and maintain  $p_{vt}$  with no flow for at least 2 s after the gas pressure has stabilized.
- h) Shut off the gas supply.
- i) De-pressurize the test sample from the valve inlet connection. Wait at least 2 s.
- j) Repeat b) to i) 1 000 times.

### 6.15.2 Filling connection non-return valve upstream of the valve operating mechanism

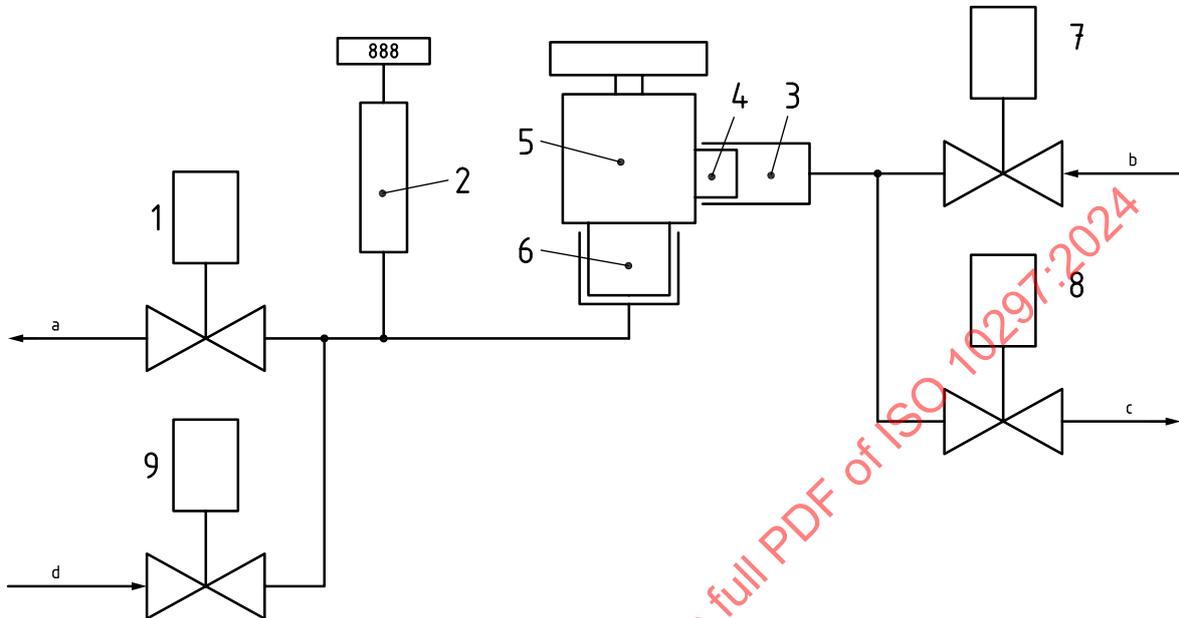
The test shall be carried out in the following order:

- a) With the valve operating mechanism in the closed position, connect a filling connector device with a retractable pin to the valve filling connection. The parameters of the retractable pin (diameter and stroke) shall be agreed between the manufacturer and the test laboratory.
- b) Mechanically open the filling connection non-return valve using the retractable pin of the filling connector device so that it is in the intended filling position, i.e. replicating the stroke of the non-return valve.
- c) Pressurize the test sample from the valve filling connection to  $p_{vt}$  and maintain  $p_{vt}$  with no flow for at least 2 s after the gas pressure has stabilized.
- d) Shut off the gas supply.
- e) Retract the pin in the filling connector device in order to allow the filling connection non-return valve to return to the closed position.
- f) De-pressurize the filling connection from the filling port side vent valve. Wait at least 2 s.

- g) De-pressurize the test sample from the valve inlet connection. Wait at least 2 s.
- h) Repeat b) to g) 1 000 times.

### 6.15.3 Test apparatus

An example of a test apparatus set-up required for this test is shown in [Figure 13](#).



#### Key

- |   |   |   |   |
|---|---|---|---|
| 1 | cylinder side vent valve                      | 8 | filling port side vent valve                  |
| 2 | high pressure transducer                      | 9 | cylinder side pressure source isolation valve |
| 3 | filling connector device with retractable pin | a | Cylinder side vent path.                      |
| 4 | test sample filling connection                | b | Filling side pressure source of $p_{vt}$ .    |
| 5 | test sample                                   | c | Filling path.                                 |
| 6 | test sample inlet connection                  | d | Cylinder side pressure source of $p_{vt}$ .   |
| 7 | filling side pressure source isolation valve  |   |   |

**Figure 13 — Example of a test apparatus set-up for valve filling connection non-return valve endurance test**

### 6.16 Visual examination

When the endurance test and the subsequent leak tightness tests have been completed, components such as diaphragms, valve operating devices and valve operating device to spindle interface for manually operated valves, bellows and o-rings shall be subjected to a visual examination.

In case of a change of the handwheel material only the handwheel and handwheel to spindle interface shall be examined.

During the visual examination, verification that one test sample or one test sample per design change or material variant and its components correspond to the submitted set of drawings shall be carried out and recorded.

NOTE It is expected that components are affected by wear and debris as a result of endurance testing.

### 6.17 Valve spindle impact test for pin-index valves

The valve spindle shall be impact tested in the closed position. The test shall be conducted after the valve operating device (handwheel, toggle, etc.) has been removed.

The valve spindle shall be impacted with an impact energy equal to a minimum of 190 J.

NOTE 1 The impact energy is chosen to reflect the dropping of a cylinder of 9,1 kg (representing the approximate weight of a typical medical cylinder used in North America with liquefied product) from a height of 2,1 m.

The impact force on the valve spindle shall be directed axially along the valve spindle at a zero-degree angle with respect to the valve spindle axis (see [Figure 14](#)). The valve shall be disassembled and be inspected for damage.

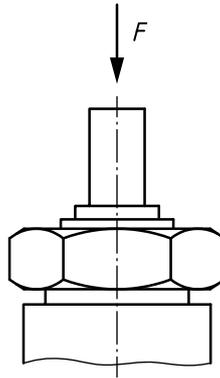


Figure 14 — Application direction for the valve spindle impact test

NOTE 2 This test has been reproduced with editorial modifications from CGA V-9—2019 with permission from Compressed Gas Association (CGA).

### 6.18 Pressure relief valve tightness test

For testing the tightness of the pressure relief valve, the valve operating mechanism and the pressure relief valve shall be in the closed position and all other openings except the valve inlet connection shall be closed or plugged.

The test shall be carried out at  $-40_{-5}^{0}$  °C and  $65_{-2,5}^{+2,5}$  °C with applying a test pressure of  $75_{0}^{+5}$  % of the nominal set pressure of the pressure relief valve.

The pressure shall be applied to the valve inlet and be raised until test pressure is reached. Once test pressure is reached, the leakage rate shall be measured after at least 1 min waiting time.

## 7 Marking

Valves conforming to this document shall be permanently and legibly marked prior to entering service by forging, etching, hard metal stamping, engraving, pin stamping, laser etching or equivalent methods, except adhesive labels, with:

- a) Coded identification of this document:
  - 1) all valves shall be marked with “ISO V” except for the following;
  - 2) main valves, which are oxygen pressure surge tested via the valve inlet connection and valve filling connection (see [C.1](#)), both with the 14 mm and 0,75 m configuration (see [Annex C, C.3](#)) shall be marked with “ISO VB”;

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- 3) main valves, which are oxygen pressure surge tested via the valve inlet connection with the 5 mm and 1 m test configuration and via the valve filling connection with the 14 mm and 0,75 m test configuration (for both see [C.3](#)) shall be marked with “ISO VBI”
  - 4) main valves, which are oxygen pressure surge tested via the valve filling connection only (see [C.1](#)) shall be marked with “ISO VBF”.
- 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 valve 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 separated from 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 permitted total package mass for which the valve has been tested shall be marked (e.g. 70 kg).
  - h) If the valve operating device closes the valve operating mechanism by rotation in an anti-clockwise direction the closing direction shall be clearly marked.

The markings given in a) to h) shall be separated, at least by one space.

Additional marking can be required, for example, by applicable regulations or customer requests.

## Annex A (normative)

### Impact test

The test sample shall be tested in the closed condition (closed to  $T_{e,start}$  in accordance with [Table 1](#)). The test sample shall be fitted into a steel gas pressure receptacle neck equipped with the corresponding screw thread, or a similar test fixture made of steel (see [Figure A.1](#)). The valving procedure shall meet ISO 13341, other industry standards or be carried out according to manufacturers published installation procedures. It shall be verified that the threaded joint between the valve and the pressure receptacle/test fixture does not leak before impact testing.

For taper threads, the test sample shall be fitted using the minimum torque value specified by the valve manufacturer. For parallel threads the test sample shall be fitted using 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, whichever is the 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 approximately two-thirds of the distance,  $L$ , from the plane where the valve inlet connection thread meets the pressure receptacle (receptacle top) to the furthest point of the valve body, measured along the longitudinal (valve inlet connection) axis of the valve (see [Figure A.1](#)).

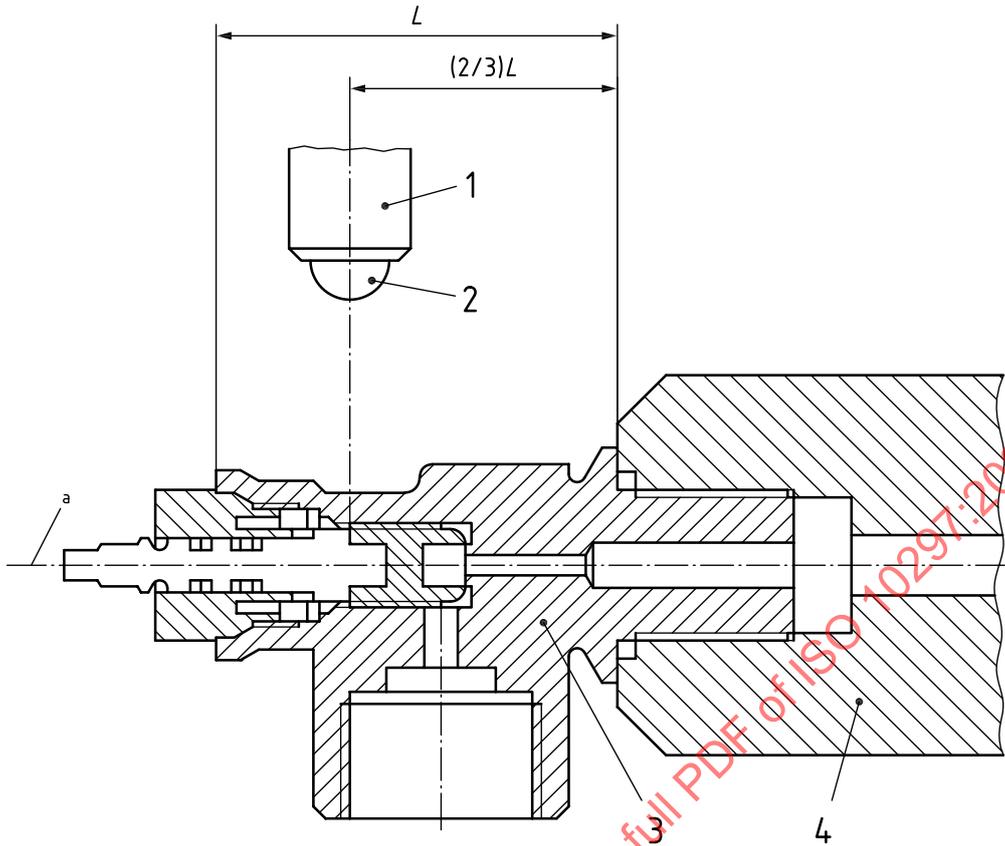
The point of impact at that location shall be chosen such that the weakest position of the valve body will be tested but shall not be obstructed by features such as outlet connecting threads, pressure relief devices, handwheel, etc.

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, e.g. "Y"-shaped valves or if the deformation of the valve body at calculated point of impact would negatively affect the valve operating mechanism functionality), a different point of impact as near as possible to the calculated point of impact shall be agreed between the manufacturer and test laboratory and a corrected impact energy value calculated and used.

The test sample shall be struck once only.

The valve shall be hydraulically pressure tested according to [6.9](#), but with  $p_{vt}$  and in the closed position only. It shall be closed with  $T_0$  in accordance with [Table 1](#).

After the hydraulic pressure test, a leak tightness test at room temperature with the test sample remaining in the closed position shall be carried out using  $p_{vt}$  only.



**Key**

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

**Figure A.1 — Impact test fixture**

## Annex B (normative)

### Tests for acetylene valves

#### B.1 Acetylene hydraulic pressure test

The test shall be carried out on three test samples according to [6.9](#) using a minimum test pressure of 450 bar for the test in the closed position and 909 bar for the test in the open position.

NOTE The test pressure of 909 bar is calculated as 26 bar absolute pressure  $\times$  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).

#### B.2 Acetylene seat leak tightness test

This particular test is specific for soft seal valve designs and need not be carried out for metal-to-metal sealing valve designs.

The test samples shall be specially prepared by the manufacturer. The soft seat assembly (lower spindle with soft seat) shall be as manufactured and then the soft seat shall be removed without damaging the seat holder e.g. subjecting the seat to a flame until completely consumed. The remaining seat holder is then assembled into a complete valve without any additional cleaning.

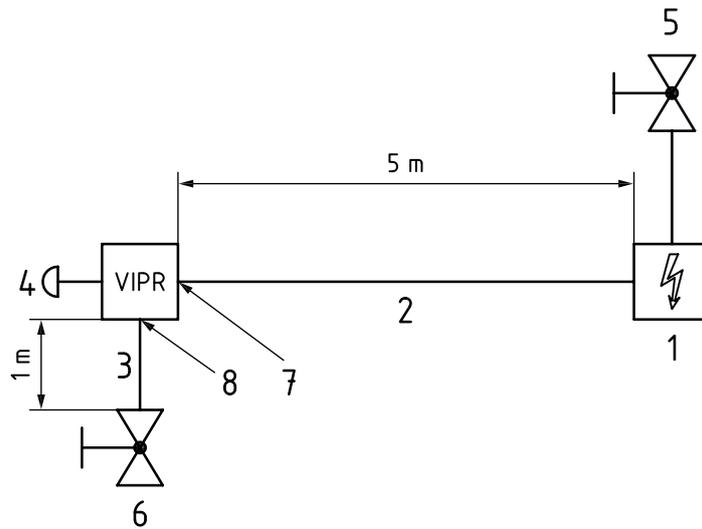
With the valve closed (to a torque of maximum 12 Nm, if applicable), the internal tightness shall be determined at  $p_{vt}$  only. For lever operated valves the valve shall be positioned in closed position.

#### B.3 Acetylene decomposition test of VIPR designs

If the VIPR has one or more pressure gauge(s), the test shall be performed without removing them. If the VIPR has a pressure relief valve, the test shall be performed without removing it.

If the valve outlet is fitted with a shut-off valve (any type, including self-closing valve), this shut-off valve shall be kept open during the test by a means recommended by the manufacturer.

The test system (see [Figure B.1](#)) shall be constructed in a way to resist the respective test conditions.



**Key**

- |   |                   |   |                         |
|---|-------------------|---|-------------------------|
| 1 | ignition source   | 5 | filling valve           |
| 2 | inlet tube        | 6 | shut-off valve          |
| 3 | outlet tube       | 7 | VIPR filling connection |
| 4 | low pressure side | 8 | VIPR inlet connection   |

**Figure B.1 — Test system for acetylene decomposition test of VIPR designs**

The length of the inlet tube connected to the filling connection of the VIPR shall be 5 m with a tolerance of  $\pm 3$  %. The length of the outlet tube connected to the cylinder connection (at cylinder neck thread) of the VIPR shall be 1 m with a tolerance of  $\pm 3$  %. The internal diameter of both tubes shall be in accordance with ISO 15615:2022, 6.7.2.

The configuration of the test sample including the filling device (if specified by the manufacturer) shall be the same as when a cylinder is being filled according to the manufacturer's filling instruction. Before testing, the whole test assembly shall be leak tested with nitrogen at 25 bar. The completely assembled test system shall be purged at least three times with acetylene. Thereafter the shut-off valve shall be closed and then filled with acetylene up to the test pressure of 25 bar with a tolerance of  $\pm 3$  %. Then the filling valve of the test assembly shall be closed.

The test should be carried out at  $(20 \pm 5)$  °C. If the temperature at the test assembly is outside this range, the pressure shall be corrected according to the ideal gas law. Consequently, the test shall be carried out at low temperatures with a lower initial pressure and at high temperatures with a higher initial pressure. For safety reasons the minimum temperature for carrying out the test is 5 °C.

The acetylene decomposition is then started by means of a fused wire or by melting a wire as part of the ignition source. Afterwards it shall be checked whether a detonation has occurred. If no detonation has occurred, the test procedure shall be repeated.

## Annex C (normative)

### Oxygen pressure surge test

#### C.1 General

All valves shall be tested via the valve filling connection.

If a valve is used in an application where it can be subjected to an oxygen pressure surge via additional connections, the oxygen pressure surge test shall be carried out via all those connections.

All main valves shall be tested via the valve filling connection and, except for specific designs of bundles of cylinders (i.e. where one single main valve is directly connected to the cylinders), via the valve inlet connection, see [Table C.1](#).

NOTE For such specific designs of bundles of cylinders, there is no possibility of pressure surge via the main valve inlet connection.

If there is a possibility of trapping pressure in the low-pressure chamber of a VIPR during the oxygen pressure surge test, this information shall be provided by the manufacturer to the test laboratory. The test laboratory shall take measures to prevent such a pressure trap by suitable means (e.g. replacement of the blind plug by an orifice, remotely operated downstream shut-off valve).

In case lubricants used are not rated for the valve test pressure; the test samples shall be pre-conditioned via the endurance cycling procedure according to [6.13](#) (without subsequent leak tightness tests and visual examination) before being oxygen pressure surge tested, see [5.2 b](#)).

#### C.2 Test apparatus requirements

The test apparatus shall meet the requirements of ISO 11114-6.

#### C.3 Test procedure

Each test shall be carried out as follows:

- a) Supply oxygen at a temperature of  $(60 \pm 3)$  °C, directly into the connection of the valve to be tested, which shall be mounted in vertical position (if possible), by means of an oxygen compatible metallic surge tube having dimensions according to [Table C.1](#). The specified dimensions of the tube are essential in order to ensure that a well-defined energy input into the valve to be tested is achieved.

**Table C.1 — Nominal dimensions of the surge tube for different applications**

Application	Dimensions for the test via the valve filling connection	Dimensions for the test via the valve inlet connection
Valves for single cylinders (marked with "ISO V", see <a href="#">Clause 7</a> )	5 mm inner diameter and 1 m length	Not applicable
Main valves for all applications (marked with "ISO VB", see <a href="#">Clause 7</a> )	14 mm inner diameter and 0,75 m length	14 mm inner diameter and 0,75 m length
Main valves connected to piping of a nominal inner diameter of maximum 5 mm (marked with "ISO VBI", see <a href="#">Clause 7</a> )	14 mm inner diameter and 0,75 m length	5 mm inner diameter and 1 m length
Main valves for applications where one single main valve is directly connected to the cylinders (marked with "ISO VBF", see <a href="#">Clause 7</a> )	14 mm inner diameter and 0,75 m length	Not applicable

- b) Perform the test sequences in accordance with the relevant table(s) for the specific valve design. The tests shall be carried out as described in the table(s) but the sequence of tests is not mandated to be in the order listed. The test consists in subjecting the test sample to 20 pressure cycles from atmospheric pressure to  $p_{vt}$ . The test sample shall be cooled down to room temperature at the start of each sequence.

For all test sequences with the valve operating mechanism in closed position, the non-pressurized valve shall be closed with a torque value, if applicable, between  $T_c$  and  $T_{e, start}$  unless otherwise specified by the manufacturer.

NOTE 1 For handwheel operated valves, it is assumed that this torque value is achieved by firmly closing the valve by hand.

For all test sequences, an open filling connection closing device refers to either an open isolating valve or a neutralized (i.e. actuated open) non-return valve.

[Table C.2](#) gives the test sequence for cylinder valves, valves for pressure drums and tubes and main valves for testing via the valve filling connection if equal to the valve outlet connection. [Table C.3](#) gives the test sequence for cylinder valves, valves for pressure drums and tubes and main valves for testing via the valve filling connection which is separated from the valve outlet connection.

**Table C.2 — Test sequence for cylinder valves, valves for pressure drums and tubes and main valves with no separated filling connection for testing via the valve filling connection**

Test no.	Valve operating mechanism	Valve inlet connection
1	Closed	Open
2	Open	Blind plugged

**Table C.3 — Test sequence for cylinder valves, valves for pressure drums and tubes and main valves with a separated valve filling connection for testing via the valve filling connection**

Test no.	Valve operating mechanism	Valve inlet connection	Valve outlet connection	Filling connection closing device (if applicable)
1	Closed	Open	Open	Open
2 <sup>a</sup>	Open	Open <sup>b</sup>	Open <sup>b</sup>	Closed
3	Open	Blind plugged	Blind plugged	Open

<sup>a</sup> Test sequence 2 is to check the resistance to ignition when the filling connection closing device is not operated (e.g. forgotten to open or non-compatible filling connector).

<sup>b</sup> If the filling connection closing device is a non-return valve activated by pressure, this connection shall be blind plugged.