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Gas cylinders — Specifications and testing of LPG cylinder valves — Manually operated

Bouteilles à gaz — Spécifications et essais pour valves de bouteilles de GPL — Fermeture manuelle

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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 documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation 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.

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 286, *Liquefied petroleum gas equipment and accessories,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 15995:2019) of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— correction of Clause 8, list item c).

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.

Introduction

This document covers the function of a LPG cylinder valve as a closure (defined by the UN Model Regulations[15]).

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

Cylinder valves complying with this document can be expected to perform satisfactorily under normal service conditions.

When an LPG cylinder valve has been approved according to a previous version of this document, the body responsible for approving the same LPG cylinder valve to this new edition should consider which tests need to be performed.

In this document the unit bar is used, due to its universal use in the field of technical gases. It should, however, be noted that bar is not an SI unit, and that the corresponding SI unit for pressure is Pa (1 bar = 10^5 Pa = 10^5 N/m^2).

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

Gas cylinders — Specifications and testing of LPG cylinder valves — Manually operated

1 Scope

This document specifies the requirements for design, specification, type testing and production testing and inspection of dedicated LPG manually operated cylinder valves for use with and directly connected to transportable refillable LPG cylinders.

It also includes requirements for associated equipment for vapour and liquid service. Bursting discs and/or fusible plugs are not covered in this document.

Annex B identifies requirements for production testing and inspection.

This document excludes other LPG cylinder devices which are not an integral part of the dedicated manually operated cylinder valve.

This document does not apply to cylinder valves for fixed automotive installations and ball valves.

NOTE For self-closing LPG cylinder valves see ISO 14245. For cylinder valves for compressed, dissolved and other liquefied gases see ISO 10297,[2] ISO 17871[6] or ISO 17879[7].

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 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 2859-1:1999, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

ISO 10286, *Gas cylinders — Terminology*

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 terminological databases for use in standardization at the following addresses:

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

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

3.1
liquefied petroleum gas
LPG
low pressure liquefied gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

[SOURCE: ISO 10286:2015, 723, modified.]

3.2
cylinder valve
valve
primary shutoff device fitted to LPG cylinders, intended for liquid or vapour filling and withdrawal

Note 1 to entry: The valve includes the *valve body* (3.8), *valve stem* (3.14), *valve outlet* (3.15) and *valve operating mechanism* (3.22).

Note 2 to entry: The valve can also include additional devices, e.g. *eduction tube* (3.5), *liquid level indicator* (3.7), *fixed liquid level gauge* (3.6), *excess flow valve* (3.9), *non-return valve* (3.10), *sediment tube* (3.19), and *pressure relief valve* (3.30).

3.3
external leak tightness
leak tightness to atmosphere (leakage in and/or leakage out), when the valve is open

3.4
internal leak tightness
leak tightness across the valve seat (leakage in and/or leakage out), when the valve is closed

3.5
eduction tube
tube fitted to the valve to allow withdrawal of liquid LPG with the cylinder in its normal operating position

3.6
fixed liquid level gauge
device such as a dip tube in combination with a vent valve to verify that the predetermined maximum liquid level in a cylinder has been reached or surpassed

3.7
liquid level indicator
device such as a float gauge, permitting the gauging of the liquid level in the cylinder

3.8
valve body
major valve component including *valve stem* (3.14) and *valve outlet* (3.15) and, where applicable, the provision for other optional components

3.9
excess flow valve
valve comprising two or more components designed to close or partially close when the flow of liquid or vapour passing through it exceeds a predetermined value and to re-open when the pressure differential across the valve has been restored below a certain value

3.10
non-return valve
automatic valve which allows gas/liquid to flow only in one direction

[SOURCE: ISO 10286:2015, 349, amended — liquid added.]

3.11
dual valve
valve designed to allow separate vapour and liquid withdrawal from a cylinder in its normal operating position each port having its own valve operating mechanism

3.12
sealing element
element used to obtain *internal leak tightness* (3.4)

3.13
special valve
valve which is only used for cylinders up to and including 7,5 l water capacity, having a hand wheel diameter less than 30 mm and where the maximum section of gas passage is not more than 4 mm diameter

3.14
valve stem
section of the *valve body* (3.8), which connects to the cylinder

3.15
valve outlet
section of the *valve body* (3.8) to which a regulator or connector can be fitted for vapour or liquid withdrawal

Note 1 to entry: The valve outlet is also normally used for filling the cylinder.

3.16
type test
test or series of tests conducted to prove that the design meets the requirements of this document

3.17
cylinder opening
part of the cylinder to which the *valve stem* (3.14) connects

3.18
test pressure
pressure at which the valve or component is tested

3.19
sediment tube
device designed to reduce the risk of foreign matter, which can be in the cylinder, entering the valve

3.20
sealing cap
device which is intended to seal the external outlet connection of a valve

[SOURCE: ISO 10286:2015, 368]

3.21
sealing plug
device which is intended to seal the internal outlet connection of a valve

[SOURCE: ISO 10286:2015, 369]

3.22
valve operating mechanism
mechanism which closes and opens the valve orifice and which includes the internal and external sealing systems

[SOURCE: ISO 10286:2015, 328, modified — EXAMPLE deleted.]

Note 1 to entry: Normally the valve operating mechanism includes the hand wheel.

3.23
operating torque
torque during opening or closing the valve, after the first half rotation of the hand wheel in opening the valve and before the last half rotation of the hand wheel in closing the valve

3.24
opening torque
initial torque required to open the valve from the closed position

3.25
closing torque
torque required to close the valve and obtain *internal leak tightness* (3.4)

3.26
valve protection cap
device securely fixed over the valve during handling, transport and storage and which is removed for access to the valve

[SOURCE: ISO 10286:2015, 360]

3.27
valve shroud
integral part of a cylinder which is permanently attached for valve protection during transportation, handling and storage

[SOURCE: ISO 10286:2015, 362]

3.28
valve guard
device securely fixed over the valve during handling transport and storage and which does not need to be removed for access to the valve

3.29
gross mass
total package mass of the heaviest cylinder on which the valve is intended to be fitted, including any permanently attached accessories and the maximum mass of the LPG content

3.30
pressure relief valve
pressure actuated valve held shut by a spring or other means and designed to relieve excessive pressure automatically by starting to open at the set pressure and reclosing after the pressure has fallen below the set pressure

3.31
nominal set pressure
predetermined pressure of the *pressure relief valve* (3.30) at which the valve is set to start to discharge

4 Design and specification

4.1 General

The valve shall be capable of withstanding:

a) operating pressures and test pressures;

b) operating temperatures and test temperature;

c) mechanical stresses during operation;

d) vibration during transport.

The valve shall be externally and internally leak tight for the full range of pressure and temperature conditions.

The valve and its optional components shall be secured to prevent unintentional disassembly during normal operation and their function shall not be affected as a result of vibration during transport.

4.2 Materials

4.2.1 General

Materials in contact with LPG shall be physically and chemically compatible with LPG under all operating conditions for which the valve is designed in accordance with ISO 11114-1 and ISO 11114-2.

In selecting an appropriate material for valve components, it is important to select not only for adequate strength in service, but also to give consideration to other modes of failure due to atmospheric corrosion, brass dezincification, stress corrosion, shock loads, and material failure.

4.2.2 Operating temperatures

Materials used shall be suitable for the temperatures for which the valve is designed.

The minimum operating temperature to which the valve is expected to be exposed during normal use is −20 °C. For some countries and for certain applications, lower minimum operating temperatures are used. When valves are designed for an operating temperature of −40 °C, they shall also meet the requirements of Annex C.

The maximum operating temperature to which the valve is expected to be exposed during normal operation is +65 °C.

4.2.3 Copper alloys

Valve bodies made from copper alloys shall be manufactured from materials in accordance with recognized international, regional (e.g. EN 12164[9] and EN 12165[10]) or national standards or from alloys of equivalent properties and standards.

4.2.4 Non-metallic materials

Non-metallic materials in contact with LPG shall be compatible with LPG and shall not fail during the valve service life. They shall not distort, harden, swell or adhere to the body or seat face to such an extent as to impair the function of the valve.

In accordance with recognized international, regional (e.g. EN 549[8]) or national standards, rubber materials in contact with LPG, for temperatures of –20 °C (–40 °C for low temperature applications) to +65 °C, shall meet the requirements for resistance to:

a) gas (n-pentane test);

b) lubricants;

c) ageing;

d) compression;

e) ozone (where the material is exposed to the atmosphere); and

f) condensate/liquid phase of combustible gases (liquid B test).

4.3 Essential components

4.3.1 Valve operating mechanism

The valve operating mechanism shall be designed in such a way that it remains captive and achieves direct contact with the valve body in the absence of the sealing element, in order to limit the leakage rate of gas and shall satisfy the requirements of 5.4. There shall be sufficient travel distance for the valve operating mechanism so that the seal housing makes contact with the seat.

The valve shall operate without difficulty, even after prolonged use, and shall satisfy the requirements of 5.13.

When a torque is applied in excess of that given in 5.10 and 5.11 the valve operating mechanism shall not disassemble from the valve body and the valve shall not leak. However, the valve operating mechanism may break or become inoperable.

The material of the hand wheel shall withstand fire engulfment such that the valve can still be closed by hand or using a simple tool after cooling, during the early stage of an incident, and shall satisfy the requirements of 5.8.

The sealing element shall be attached or otherwise assembled and shall not become dislocated under service conditions to ensure internal leak tightness. The means to secure the sealing element shall not rely only on adhesive.

All valves shall close when turned clockwise and open when turned anti-clockwise. The hand wheel shall be visibly marked with a portion of circle terminating by two arrows. One arrow shall be marked with "–" (closure) and the other arrow with "+" (opening) to indicate the result of the rotation.

4.3.2 Valve body

If the valve body is made of more than one part, precautions shall be taken to ensure that there can be no unintentional disassembly.

4.3.3 Valve stem

Valve inlet connections shall conform to an international, regional or national standard.

NOTE Valve inlet connection standards are for example ISO 11363-1[3] and ISO 15245-1[5].

The design of the valve stem shall prevent leakage, loosening in service, and meet the requirements of 5.7.

Tapered valve stems shall withstand the torque identified in Table 3, without causing such damage as to affect performance, valve operating mechanism, internal leak tightness and external leak tightness. However, such torque values shall not be used for normal operational applications, see ISO 13341. Parallel threaded valve stems shall withstand the torque identified in 5.7 d).

4.3.4 Valve outlet

Valve outlet connections shall conform to an international, regional or national standard.

NOTE Valve outlet connection standards are, for example, ISO 5145[1] and EN 15202[12].

In the case of a vapour/liquid dual valve, the following requirements shall apply:

a) The valve shall have separate vapour and liquid outlet connections. The wall thickness between the passageways through the valve body shall not be less than 1 mm.

b) The liquid outlet shall be a different design from that of the vapour outlet. Valves with liquid and vapour outlets shall have clear identification to distinguish between them, such as different connection geometry and/or marking the outlet connections.

c) It shall not be possible to obtain a flow from the liquid outlet before a leak tight connection has been made. This shall be verified by dimensional check in accordance with 5.4.

4.3.5 Excess flow valve

Valves with passageways of cross-sectional area equivalent to or greater than a 3 mm diameter hole for liquid, or an 8 mm diameter hole for vapour, shall be protected by an excess flow valve (see 4.4.5).

This requirement is not applicable for hot air balloon applications where a risk assessment identifies that the fitting of an excess flow valve would constitute a significant hazard.

4.4 Optional components

4.4.1 General

Optional components, if fitted, shall meet the following requirements.

All optional components necessary for the correct function of the valve, shall be secured to prevent unintentional disassembly during normal operation and/or their function shall not be affected, as a result of vibration during transportation.

Valves including their intended optional components shall be designed to ensure external and internal leak tightness.

4.4.2 Pressure relief valve

Pressure relief valves shall be designed to operate in the vapour phase. Pressure relief valves for LPG cylinders shall conform to an international, regional (e.g. EN 13953[11]) or national standard.

4.4.3 Eduction tube

Eduction tubes shall be securely fitted to the valve to ensure that they do not disassemble during operation, for example using adhesive, press fitting or any other mechanical means.

4.4.4 Fixed liquid level gauge

Fixed liquid level gauges that operate by means of temporarily venting a limited quantity of LPG shall meet the following requirements:

a) The cross-section of the passage way through the gauge body shall at some point be limited to an area equivalent to or less than a 1,5 mm diameter hole.

b) The orifice shall be controlled by a vent screw.

c) The vent screw shall remain captive or be permanently attached to the gauge body.

The length of the dip tube should be sized to match the maximum liquid contents of the cylinder.

4.4.5 Excess flow valve

Excess flow valves shall be designed so that the excess flow valve function does not interfere with the operation of a pressure relief valve and/or fusible plug.

Excess flow valves shall be designed so that when closed the flow past the seat, to allow for reduction of differential pressure across the valve, shall not exceed that of an opening of 1,8 mm^2 cross sectional area.

Excess flow valves shall operate at a flow-rate of not more than 10 % above, nor less than 20 % below the rated closing flow capacity specified and it shall close automatically at a pressure differential across the valve of not more than 1,4 bar.

The connection to the cylinder shall not affect the function of the valve or its rated flow.

4.4.6 Non-return valve

Non-return valves with soft seats shall maintain internal tightness throughout the valve service life.

Non-return valves shall be designed so that, when closed, the reverse flow past the seat meet the requirements of 5.15.2 at room temperature (typically between 15 °C and 30 °C).

4.4.7 Liquid level indicator

Liquid level indicators shall be designed not to interfere with the performance of the pressure relief valve or excess flow valve (if fitted).

4.4.8 Sealing cap and sealing plug

The valve may also be fitted with a sealing cap or sealing plug. Sealing caps and sealing plugs shall conform to an international, regional (e.g. EN 16119[13]) or national standard.

4.4.9 Sediment tube

The sediment tube inlet shall be in the vapour space when the cylinder is in its normal operating orientation at its maximum fill and operating temperature.

4.5 Leak tightness

The leak rate for external and internal leak tightness shall not exceed the value specified in 5.6.2.

The external leak tightness shall be assured for different positions of the valve operating mechanism, from fully open to complete closure and in between.

4.6 Operating torque

The operating torque shall not exceed 3 Nm during the valve service life and therefore shall meet the requirements of 5.12 and 5.6.

Special valves shall meet the requirements of Annex A.

4.7 Closing torque

The closing torque shall not exceed 3 Nm during the valve service life and therefore shall meet the requirements of 5.12 and 5.6.

The valve shall be able to withstand an excessive closing torque and shall therefore meet the requirements of 5.10.2.

Special valves shall meet the requirements of Annex A.

4.8 Opening torque

After application of the closing torque, the torque required to open the valve shall not exceed 4 Nm and therefore shall meet the requirements of 5.12.

The valve shall be able to withstand an excessive opening torque and shall therefore meet the requirements of 5.11.2.

Special valves shall meet the requirements of Annex A.

5 Valve type test

5.1 General

5.1.1 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.

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

The test regime shall be in accordance with Table 1.

Special valves shall meet the requirements of Annex A.

The failure to meet any of these test requirements shall be a cause for rejection of the valve design.

A type test is only valid for a given valve design.

5.1.2 Changes within the valve design which could adversely affect valve performance require tests to be repeated using the number of test samples quoted in Table 1 including:

a) changes of the valve body material (repetition of any tests to be decided case by case depending on changes of chemical composition and mechanical properties);

b) change of the hand wheel material (repetition of endurance test, subsequent leak tightness tests, excessive torque tests and hand wheel fire exposure test);

c) increase of the hand wheel diameter (repetition of excessive opening and closing torque test, endurance test, subsequent internal leak tightness tests and visual examination);

d) changes of the basic design dimensions of the valve components [e.g. spindle diameter, spindle thread pitch, seat diameter, dimension of o-ring(s)] (repetition of tests to be decided case by case depending on the change);

e) changes of metallic material of the valve operating mechanism components (e.g. spindle, springs) (repetition of tests to be decided case by case depending on the change);

f) changes of the thread and/or any dimension of the valve inlet connection (only repetition of impact test, stem test and hydraulic pressure test, to be decided case by case depending on the change);

g) change of non-metallic material with regard to composition or hardness of valve components (e.g. seals, o-rings and lubricants) (repetition of full type testing except valve stem test);

h) addition or removal of optional components like non-return valve (repetition of any tests to be decided case by case depending on the change). Removal of a pressure relief valve will not require any tests to be repeated. Addition of a pressure relief valve will require repetition of hydraulic pressure test and impact test only;

i) design changes of optional components, excluding decreases of overall length, shall require a repetition of the vibration test; and

j) changes of the thread and/or any dimension of the valve outlet connection (only repetition of hydraulic pressure test in open position, to be decided case by case depending on the change).

5.2 Test samples

In general, test samples shall be presented in their final condition representative of their intended use, with all essential components in place.

Additional test samples may be required for changes within the valve design in accordance with 5.1.2.

Where an optional component can be shown not to be affected by a test, the component need not be present on the valve during the type test.

The fixed liquid level gauges excluding the dip tube shall be fitted to the valve during type testing.

For valves designed to incorporate pressure relief valves their ports shall be plugged or sealed or their setting shall be adjusted to apply the test pressure without activating the pressure relief valve.

5.3 Test procedure and test requirements

Each test shall be carried out in accordance with the relevant clause designated in Table 1.

Table 1 — Valve test sequence

Test	Test detail	Clause	Condition of test valve	Temperature at which the test is performed °C	Test sample number
1	Inspection	5.4	As received	Room temperature	Random sample
2	Hydraulic pressure	5.5	As received	Room temperature	1
3	External and internal leak tightness	5.6	From test no. 2	Room temperature	1
4	Valve stem	5.7	As received	Room temperature	2
5	External and internal leak tightness	5.6	From test no. 4	Room temperature	2
6	Hand wheel fire exposure	5.8	As received	See 5.8	3
7	Impact	5.9	As received	Room temperature	4
8	External and internal leak tightness	5.6	From test no. 7	Room temperature	4
9	Excessive closing torque	5.10	As received	Room temperature	5 and 6
10	Internal leak tightness	5.6	From test no. 9	Room temperature	5 and 6
11	Excessive opening torque	5.11	As received	Room temperature	7 and 8
12	External leak tightness	5.6	From test no. 11	Room temperature	7 and 8
13	External and internal leak tightness	5.6	As received	Room temperature	9 to 13
14	Endurance — Part 1 Endurance — Part 2	5.12	From test no. 13	Room temperature	9 to 13
15	External and internal leak tightness — low temperature	5.6	From test no. 14	$-20^{\ 0}_{-5}$	9 to 13
16	External and internal leak tightness — high temperature	5.6	From test no. 15	$65^{+2,5}_{-2,5}$	9 to 13
17	External and internal leak tightness	5.6	From test no. 16	Room temperature	9 to 13
18	Examination of disassembled valves	5.13	From test no. 17	Room temperature	9 to 13
19	Excess flow valve, if fitted	5.14	As received	Room temperature	14 to 16
20	Non-return valve, if fitted	5.15	As received	Room temperature	17 to 19
21	Vibration test	5.16	As received	Room temperature	20 to 22
22	Internal leak tightness	5.6	From test 21	Room temperature	20 to 22

NOTE Room temperature means typically between 15 °C and 30 °C.

5.4 Inspection

The documentation (see Clause 6) for the test samples shall be reviewed in advance of testing taking place. The samples presented for type testing shall be inspected to confirm conformance to the manufacturer's valve design, specification, operation and intended use, prior to testing taking place.

A dimensional check of the assembled valve, as submitted for type testing, shall also be carried out to confirm the dimensions in accordance with the specification/drawings including that the dimensions of the connections are to a recognised international (e.g. ISO 11363-1[3]), regional (e.g. EN 15202) or national standard.

The valve drawings shall be examined to determine that there is metal to metal contact between the valve body and the valve operating mechanism with the sealing element removed.

5.5 Hydraulic pressure test

5.5.1 Procedure

This test shall be carried out with the following procedure:

a) The number of cycles shall be 1.

b) The test medium shall be water or other suitable fluid.

c) The test pressure shall be 45 bar.

d) The valve operating mechanism shall be closed using a torque of less than 12 Nm.

e) Pressure shall be applied through the inlet using a fitting reproducing the cylinder opening.

f) The pressure shall be raised continuously and gradually.

g) The test pressure shall be held for at least 2 minutes.

h) The test shall then be repeated with the valve operating mechanism in the open position and with the outlet sealed.

5.5.2 Requirement

The valve shall withstand the test without permanent deformation, rupture or leak, see test no. 3 (Table 1).

5.6 External and internal leak tightness tests

5.6.1 Procedure

5.6.1.1 General

The valves shall be subjected to the tests in 5.6.1.2 and 5.6.1.3 in accordance with the following criteria:

a) The test medium shall be air or nitrogen.

b) For test no. 17 and 18 (Table 1) the valve shall be heated or chilled to the required temperature and stabilised before test pressure is applied and the leak test is carried out.

c) Each external and internal tightness test sequence shall include a test at two pressure settings as shown in Table 2.

Table 2 — Test pressures

No.	Test pressure bar gauge
1	0,1
2	30

The pressure shall be applied through a fitting reproducing the cylinder opening.

5.6.1.2 External leak tightness test

External leak tightness shall be determined in accordance with the following procedure on each valve:

a) The outlet and components shall be sealed.

b) The valve operating mechanism shall be in the open position.

c) The specified pressure shall be applied to the open valve.

d) After a period of at least 1 min, the external leak tightness shall be checked. The check shall last at least 1 min.

e) The test shall be repeated when the valve is approximately one quarter, one half and three quarters closed.

5.6.1.3 Internal leak tightness test

Internal leak tightness shall be determined in accordance with the following procedure on each valve:

a) The valve shall be closed under pressure with a torque not exceeding 3 Nm.

b) The outlet shall be depressurized.

c) After a period of at least 1 min the internal leak tightness shall be checked. The check shall last at least 1 min.

d) The valve shall be depressurized.

5.6.2 Requirement

The leak rate for the external and internal tightness shall not exceed 15 cm^3/h of air corrected to 15,6 °C and 1,013 bar, at pressures specified in Table 2 and temperatures specified in Table 1.

5.7 Valve stem test

5.7.1 Procedure

This test shall be carried out with the following procedure:

a) The number of cycles shall be 1.

b) A mild steel fitting reproducing the cylinder opening with matching threads shall be used without thread sealant or lubricant.

c) The threaded tapered valve stem shall be tightened to the torque settings as shown in Table 3.

NOTE The torque values given in Table 3 are intended for the sole purpose of giving an indication of the strength of the valve stem.

Table 3 — Minimum required torque for threaded tapered valve stems

Valve stem major diameter — Large end diameter mm	Torque Nm
≤19,8	150
>19,8 < 28,8	220
≥28,8	270

d) The threaded parallel valve stem shall be tightened to a minimum torque of 130 Nm.

5.7.2 Requirement

The valve shall not be damaged so as to affect its performance or valve operating mechanism.

This shall be checked by a subsequent external and internal leak test in accordance with 5.6.

5.8 Hand wheel fire exposure test

5.8.1 Procedure

This test shall be carried out with the following procedure:

a) The number of cycles shall be 1.

b) The hand wheel shall be exposed for 1 min (+5/0 s) to a gas torch flame of 150 mm length, without an additional air supply, such that the flame reaches a temperature of 800 °C to 1 000 °C.

c) The hand wheel shall be completely enveloped by the flame for the required duration and then shall be allowed to cool naturally.

5.8.2 Requirement

The valve shall still be capable of being closed by hand or using a simple tool after cooling.

5.9 Impact test

5.9.1 General

A valve, which is designed to be used only on cylinders protected by a valve protection cap, valve guard or valve shroud, shall be submitted to an impact test using an impact energy of 40 J.

A valve, which is not designed to be protected by a protection cap, valve guar or valve shroud, shall be submitted to an impact test with an impact value determined in accordance with Formula (1):

$$J = 3{,}6 \times M \tag{1}$$

where

J is the impact value (J);

M is the gross mass (kg).

5.9.2 Procedure

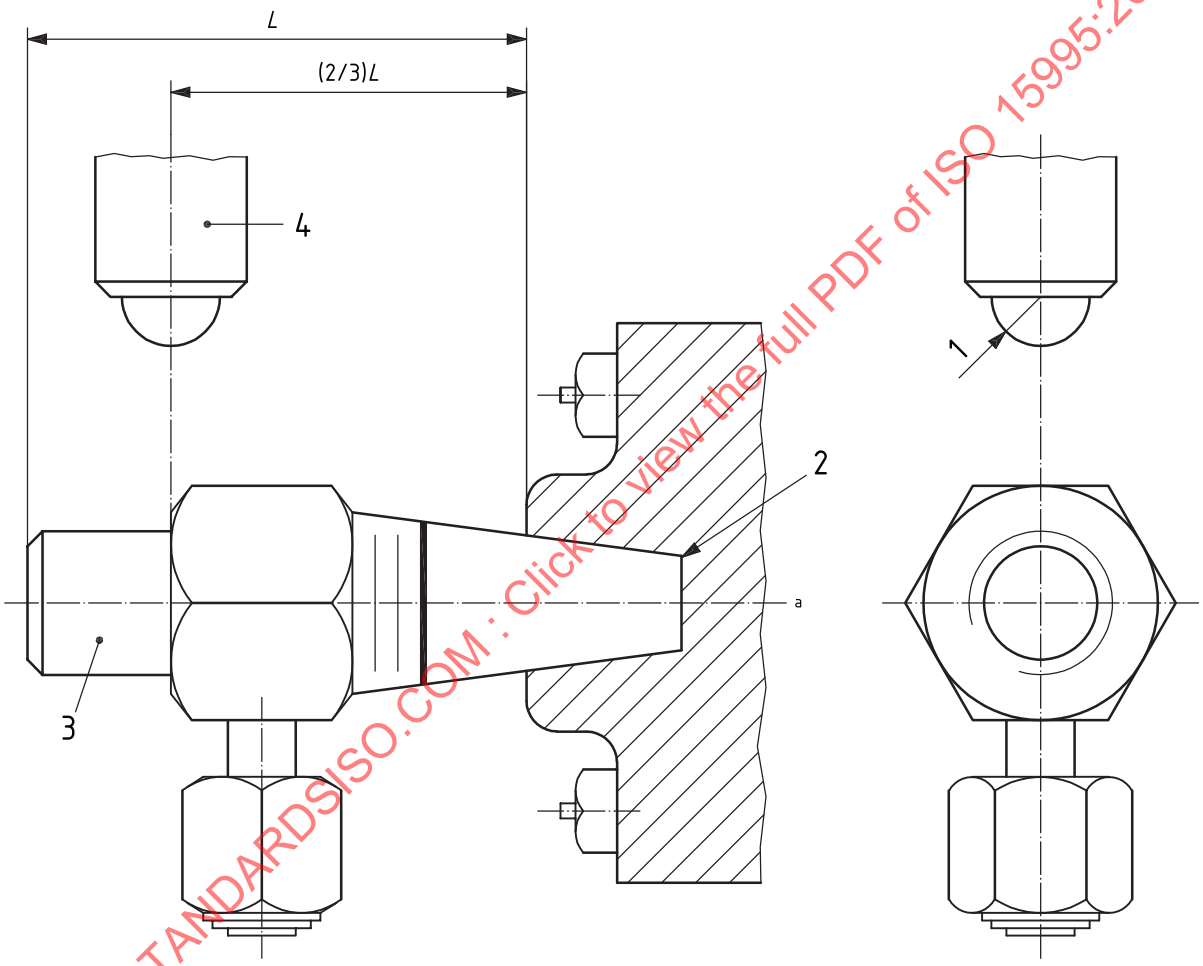
The test sample shall be tested in the closed condition (closed with 3 Nm). The test sample shall be fitted into a fixture representative of its intended use. The valve fitting procedure shall meet the requirements of ISO 13341, other industry standards or be carried out in accordance with manufacturers published installation procedures.

For taper threads the test sample shall be fitted using the minimum of all given torque values for the tested valve inlet connection or the minimum torque value specified by the valve manufacturer. For parallel threads the test sample shall be fitted using the maximum of all given torque values for the tested valve inlet connection or 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 gross mass in kilograms, with a relative tolerance of ±2,5 %.

EXAMPLE A gross mass of 13 kg requires an impact test with 46,8 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.



Key

1 13 mm diameter hardened steel ball
2 fixture or cylinder
3 valve
4 plummet weight
a Longitudinal axis.

Figure 1 — Impact test

The point of impact shall be two-thirds of the distance, *L*, from the plane where the valve inlet connection thread meets the cylinder to the furthest point of the valve (including the closed hand wheel), measured along the longitudinal axis of the valve (see Figure 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 valves, hand wheel, 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), a different point of impact shall be chosen and a corrected impact energy value calculated and used.

The test sample shall be subjected to only one impact from the plummet weight.

5.9.3 Requirement

The valve shall not crack or shear to such an extent that LPG would be released. This shall be verified by performing an internal leak tightness test according to 5.6 and checking the leak tightness from the valve body.

5.10 Excessive closing torque test

5.10.1 Procedure

This test shall be carried out with the following procedure:

a) The number of cycles shall be 1.

b) The test shall be carried out without internal pressure on the valve.

c) The torque shall gradually be increased up to the value of 20 Nm.

5.10.2 Requirement

At this torque, the valve shall be able to work without noticeable difficulties and shall not show any significant damage.

The valve operating mechanism shall not disassemble from the valve body and not result in a leak. However, the valve operating mechanism may break or become inoperable.

For subsequent operation, after 20 Nm is reached, the valve shall not require an operating torque greater than 3 Nm.

The internal leak tightness of the valve shall be maintained. This shall be verified by performing an internal leak tightness test according to 5.6.

5.11 Excessive opening torque test

5.11.1 Procedure

This test shall be carried out with the following procedure:

a) The number of cycles shall be 1.

b) The test shall be carried out without internal pressure on the valve.

c) The torque shall gradually be increased up to the value of 25 Nm.

5.11.2 Requirement

At this torque, the valve shall be able to work without noticeable difficulties and shall not show any significant damage.

The valve operating mechanism shall not disassemble from the valve body and not result in a leak. However, the valve operating mechanism may break or become inoperable.

For subsequent operation, after 25 Nm is reached, the valve shall not require an operating torque greater than 3 Nm.

The external leak tightness of the valve shall be maintained. This shall be verified by performing an external leak tightness test according to 5.6.

5.12 Endurance test

5.12.1 Procedure

The test shall be in two parts designated part 1 and part 2. The following procedure shall be applicable to both parts:

a) The inlet pressure shall remain at 12 bar.

b) Rotational speed shall be 100 ± 5 turns per min.

c) Opening shall be three quarters of total stroke.

d) Open time shall be at least 6 s.

e) Closing torque shall be $3^{\ 0}_{-0,3}$ Nm.

f) Closed time shall be at least 6 s.

After each closure, the pressure downstream of the valve seat shall be released to the atmosphere.

The tests shall be carried out using air or nitrogen.

Care should be taken to ensure that, due to friction, there is no excessive temperature rise in the valve during the test.

The part 1 test shall consist of 10 000 cycles (openings/closings) without a load on the hand wheel.

The part 2 test shall consist of 3 000 openings/closings with a load of 200 N applied vertically on the hand wheel for the duration of the test.

5.12.2 Requirement

Any failure, deformation, excessive wear or cracks that affect the normal operation of the valve shall be a cause for rejection. This shall be verified by performing an examination of dismantled valves according to 5.13.

The operating torque and the closing torque shall then be checked to ensure that they do not exceed 3 Nm. The opening torque shall not exceed 4 Nm. This shall be verified by performing an external leak tightness test according to 5.6.

5.13 Examination of dismantled valves

5.13.1 Procedure

The valves shall be dismantled and examined for deformation, wear and cracks.

A dimensional check of one dismantled valve shall also be carried out to confirm the sealing and spindle dimensions in accordance with the specification/drawings.

5.13.2 Requirement

Any failure, deformation, excessive wear or cracks that affect the normal operation of the valve shall be a cause for rejection.

5.14 Excess flow valve test

5.14.1 General

Three samples of each size and type of valve which includes an excess flow valve shall be subjected to these tests. A valve intended for use only with liquid shall be tested with water, otherwise the tests shall be made both with air and with water. Separate tests shall be carried out with each sample installed in vertical, horizontal and inverted positions. A valve intended for installation in one position only, may be tested only in that position.

NOTE Other suitable test gases can be used, e.g. nitrogen.

The valve shall meet the requirements of 4.4.5, during the tests described in 5.14.2 and 5.14.3.

5.14.2 Excess flow valve test with air

The tests shall be made without piping or other restrictions connected to the outlet of the test sample.

The test shall be conducted by using an appropriately designed and calibrated flow meter connected to an air supply of adequate capacity and pressure. The upstream pressure of the air supply shall remain within ±2 % of the set value during the test, until closure is achieved.

The valve shall be connected to the outlet of the flow meter. A recording pressure gauge shall be installed on the upstream side to indicate the closing pressure.

The test shall be conducted by slowly increasing the flow of air until the excess flow valve closes. At the instant of closing, the flow-rate shall be determined and the closing pressure recorded.

The test shall be conducted for the set values of upstream air pressure of 2 bar and 7 bar.

Air flow shall be recorded in m^3/min, for each pressure setting.

These flow rate test results shall be converted from flow rate of air to the flow rate of either propane or butane. LPG vapour flow-rate shall be derived from Formula (2):

$$Q_{LPGv} = Q_{AIR}\sqrt{\frac{\rho_{AIR}}{\rho_{LPGv}}} \tag{2}$$

where

Q_{LPGv} is the volume flow-rate of LPG vapour;

Q_{AIR} is the volume flow-rate of air;

ρ_{AIR} is the density of air; (1,225 kg/m^3);

ρ_{LPGv} is the density of LPG vapour (Butane 2,45 kg/m^3, Propane 1,85 kg/m^3).

5.14.3 Excess flow valve test with water

The test with water shall be conducted using an appropriately designed and calibrated liquid flow meter installed in a piping system having sufficient capacity to provide the required flow.

Prior to the test air shall be eliminated from the system. The test shall be conducted by slowly increasing the flow until the excess flow valve closes. Just before the instant of closing, the rate of flow shall be

recorded. This closing flow-rate shall be expressed in m^3/min of liquid LPG. The LPG flow-rate shall be derived from Formula (3):

$$Q_{LPG} = Q_{WATER} \sqrt{\frac{\rho_{WATER}}{\rho_{LPG}}} \quad (3)$$

where

Q_{LPG} is the volume flow-rate of liquid LPG;

Q_{WATER} is the volume flow-rate of water;

ρ_{LPG} is the density of liquid LPG (Propane 510 kg/m^3, Butane 575 kg/m^3);

ρ_{WATER} is the density of water (1 000 kg/m^3).

5.14.4 Excess flow strength test

Each valve shall be subject to a strength test by the application of a differential pressure of 30 bar to close the valve.

After the test, the valve shall be visually inspected, and shall not show signs of damage that will interfere with normal operation.

5.15 Non-return valve test

5.15.1 Procedure

This test shall be carried out with the following procedure for non-return valves with a soft seat:

a) The number of cycles shall be 1 000.

b) The tests shall be carried out using air or nitrogen.

c) The pressure shall be 12 bar and shall be applied from the upstream (cylinder) side of the non-return valve.

d) From the closed position, the non-return valve shall be opened according to manufacturer's specification and closed again.

e) After each closure, the pressure downstream of the seat of the non-return valve shall be released to the atmosphere.

f) The cycle time shall be a minimum of 5 s. Care shall be taken to ensure that there shall be no excessive temperature rise due to friction or temperature drop in the valve during the test.

5.15.2 Requirement

Any failure, deformation, excessive wear or cracks that affect the normal operation of the valve shall be a cause for rejection.

Valves shall be subjected to an internal tightness test at room temperature and from the downstream side of the valve at pressures specified in Table 2. The leak rate shall not exceed 15 cm^3/h.

5.16 Vibration test

5.16.1 Procedure

The vibration test shall be carried out in accordance with Annex D, except where a valve design does not include any optional components other than pressure relief valves and sealing caps/ plugs.

The test sample shall be fitted with all intended optional components.

5.16.2 Requirement

After being subjected to the vibration test each valve shall be internally and externally leak tested according to 5.6 at room temperature only.

Each valve shall then be visually inspected to ensure there is no distortion that could adversely affect the function of the valve. In particular, any eduction tubes or dip tubes shall be inspected to ensure correct orientation and fixing and that no permanent deformation is present.

6 Documentation and test report

6.1 Documentation

The following shall be available for carrying out the tests:

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);

b) manufacturer drawings of sufficient detail, including dimensions and tolerances;

c) test sample verification (any change and/or material variant within the given valve design shall be clearly identified);

d) information about lubricants and adhesives, their approximate amounts and where they are applied;

e) description of valve and method of operation including information in relation to fitting procedures and fitting torques and any limitations;

f) information on the intended use of the valve (e.g. LPG mixtures, pressures, temperatures, connections, use with or without valve protection cap, valve guard or valve shroud);

g) certificates relating to material suitability and compatibility with LPG.

6.2 Test report

A written report shall be prepared detailing the tests carried out, the results from each test and reference to the documentation given in 6.1.

7 Production testing

Production testing shall be carried out in accordance with Annex B.

8 Markings

Cylinder valves meeting the requirements of this document shall be permanently marked with the following:

a) manufacturer's designation or logo;