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

Bouteilles à gaz — Chapeaux fermés et chapeaux ouverts de protection des robinets — Conception, construction et essais

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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*.

This third edition cancels and replaces the second edition (ISO 11117:2008), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11117:2008/Cor.1:2009. The main changes compared to the previous edition are as follows:

— clarification of requirements for "ISO P A" marking,

— removal of Figure 2,

— substitution of Figure 1 by Figure 1 a) and b), and Figure 3 a) and b),

— addition of other threads than W 80 × 1/11,

— renaming and modification of the "axial test" as "vertical pull test",

— modification of the "drop test" including acceptance criteria,

— modification of marking requirements,

— addition of requirements for the test report,

— removal of normative Annex A "Marking of caps".

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 devices intended for the protection of cylinder valves, where such protection is fitted to allow safe transport, handling and storage.

This document specifies the principal dimensions, requirements for fitment and drop test procedure, to confirm the provision of adequate valve protection, in the event of the occurrence of a cylinder toppling from its base.

This document has been written so that it is suitable to be referenced in the UN Model Regulations[1].

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

1 Scope

This document specifies the requirements for valve protection caps and valve guards used on cylinders for liquefied, dissolved or compressed gases.

Valve protection caps and valve guards are some of the options available to protect cylinder valves, including valves with integral pressure regulators (VIPRs) during transport.

This document is applicable to valve protection caps and valve guards which inherently provide the primary protection of a cylinder valve. It can also be used to test other equipment (e.g., handling devices) attached to cylinder packages, even in cases where the cylinder valve is inherently able to withstand damage without release of the content.

This document excludes protection devices for cylinders with a water capacity of 5 l or less and cylinders whereby the protection device is fixed by means of lugs welded or brazed to the cylinder, or is welded or brazed directly to the cylinder. This document does not cover valve protection for breathing apparatus cylinders.

NOTE Small cylinders (e.g., medical cylinders) are commonly transported in an outer-packaging (e.g., pallet) to meet transport regulations.

This document does not specify requirements that could be necessary to enable the valve protection device to be used for lifting the cylinder.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10286, *Gas cylinders — Terminology*

ISO 10297:2014, *Gas cylinders — Cylinder valves — Specification and type testing*

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

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 http://www.iso.org/obp.

3.1
valve protection cap
device protecting the valve during handling, transport and storage, which is removed for access to the valve to allow for connection, disconnection, opening and closing

[SOURCE: ISO 10286:2015, 360, modified]

3.2
valve guard
device protecting the valve during handling, transport and storage, which does not need to be removed for access to the valve

Note 1 to entry: There are two types of valve guards: rotational and non-rotational valve guards.

[SOURCE: ISO 10286:2015, 361, modified and Note 1 to entry added.]

3.3
test valve
valve used for the drop test to qualify the valve protection device

3.4
permitted mass
maximum mass of the cylinder package, including its permanent attachments and its maximum contents, to which the protection device is intended to be fixed

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.

4 General requirements for valve protection cap and valve guard

4.1 Valve protection cap

A valve protection cap shall be of adequate strength to protect the valve.

It shall be capable of being securely fixed to the cylinder, either by screwed thread or other suitable means.

Figure 1 gives examples of valve protection caps.

The dimensions given in Figure 1 are only mandatory in the special case that valve protection caps are designed to protect valves that have dimensions in accordance with Figure 2, and that the value c for the height to the reference plane "*top of the cylinder*" (Key 1) in Figure 3 is as given there (i.e., ≤25 mm). Such valve protection caps will be eligible for a specific marking (see Clause 8).

Provision should be made to assist fitting or removal of the valve protection cap, for example, by inclusion of a hexagonal boss enabling use of a wrench.

NOTE Some valve protection caps not containing an inherent removal provision can be removed using a special tool.

The valve protection cap shall be provided with sufficient venting capacity equating to a cross-sectional area of at least 157 mm^2 for a typical conventional cylinder valve.

Possible examples are:

— using two or more vent holes of at least 10 mm diameter (see Figure 1) situated symmetrically so that any thrust caused by venting gas is balanced,

— using other means of venting, e.g., lifting under pressure (see Figure 6 a).

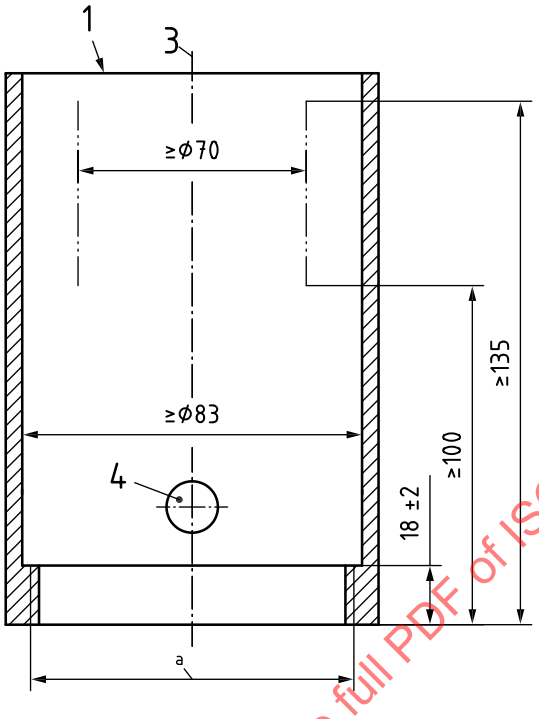
Quick-release cylinder valves as designed according to ISO 17871 can have a larger discharge capacity than typical conventional cylinder valves. In such a case, the venting capacity of the valve protection cap shall be assessed.

Water drainage shall be considered for all types of valve protection caps.

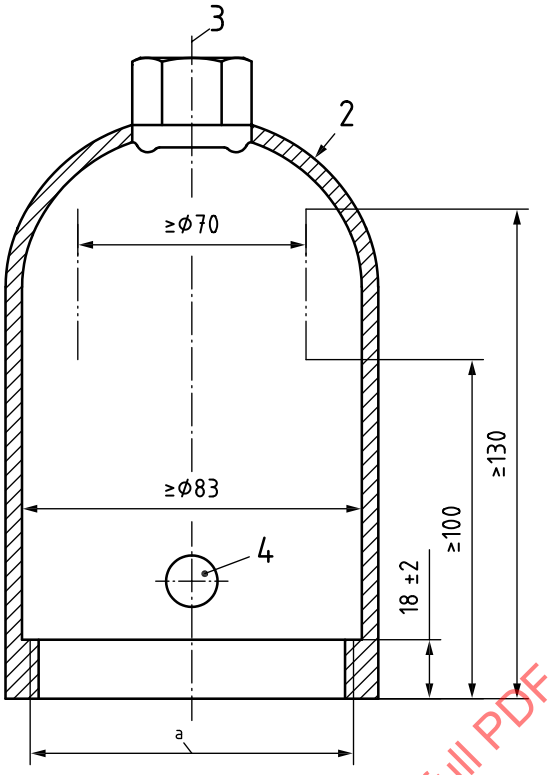
If a threaded fixing connection is used, it is recommended to conform to the dimensions given in Figure 4 or Figure 5. The valve protection cap shall be of such dimensions as not to contact any part of the valve.

For thread dimensions, see Tables 1 to 4.

Dimensions in millimetres



a) Open valve protection cap



b) Closed valve protection cap

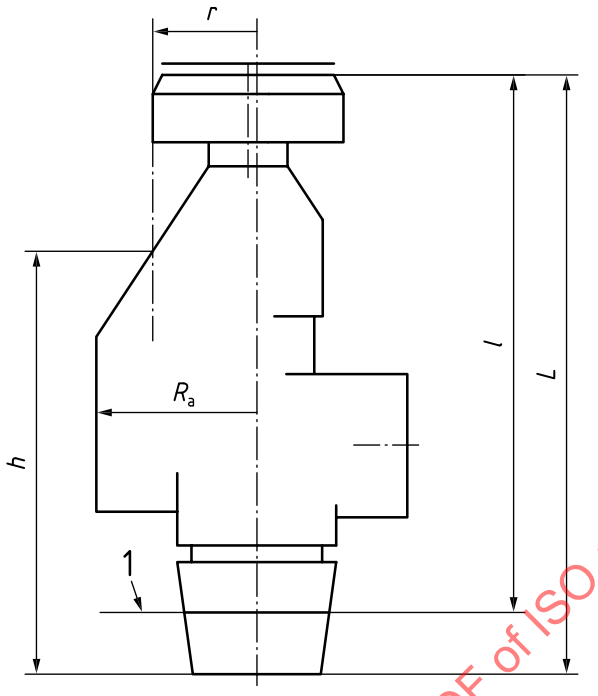
Key

1	open valve protection cap	3	cylinder axis
2	closed valve protection cap	4	vents Ø ≥ 10 mm, diametrically opposed

NOTE The outlines and dimensions given are typical for ISO valve protection caps in common use. W 80 × 1/11 fixing connection (see Figure 4 and Tables 1 and 2) is commonly used. Any other shape, dimensions and/or connection thread can be used (see e.g., Figure 5 and Tables 3 and 4), provided they give appropriate clearance around the valve.

[a] Thread with a major diameter between 78–80 mm.

Figure 1 — Examples of valve protection caps with basic dimensions for valves according to Figure 2



Key

$r \leq 32{,}5$ mm — $h \leq 90$ mm

$R \leq 38$ mm — $L \leq 125$ mm

1 reference plane (top of the cylinder) as given in Figure 3 — $l \leq 105$ mm

[a] R shall be measured to the part of the valve furthest from the valve stem axis and includes any valve outlet plugs or caps if fitted.

NOTE 1 h represents the length of the lower part of the valve when R is greater than r.

NOTE 2 L is the overall length of the valve along the axis of the valve inlet connection in the closed position when not fitted to a cylinder.

NOTE 3 r relates to the axis of the valve inlet connection and not to the centreline of the valve operating device.

NOTE 4 This figure is based on ISO 10297:2014, Figure 9.

Figure 2 — Dimensions of a cylinder valve

4.2 Valve guard

A valve guard shall be of adequate strength to protect the valve.

It shall be fixed so as to prevent inadvertent removal by the end user or dismantling under normal service conditions.

Consideration shall be given to the design of valve guards fixed only to the valve to ensure the valve guard does not initiate unscrewing of the valve from the cylinder.

The design of valve guards and their mounting on the cylinder package shall permit ease of access for valve operation and assembly of operational equipment. Rotational valve guards shall be capable of easy manual orientation to allow alignment of openings with the valve connections.

If the valve guard is fixed only to the valve and not fixed to the cylinder then, in addition to the requirements for valve guards included in this document, the valve type, in an unguarded state, shall pass the valve impact test according to ISO 10297:2014, Annex A (including ISO 10297:2014/Amd.1:2017).

NOTE In this situation, the valve to cylinder connection is confronted with the impact load. Its capability to withstand this load is verified by the valve impact test described in ISO 10297:2014, Annex A (including ISO 10297:2014/Amd.1:2017).

Provisions for water drainage shall be considered.

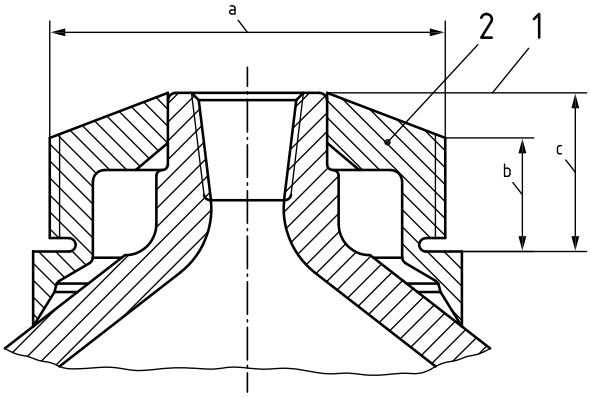
The valve guard shall not prevent full operation of the valve when the valve operating device is in any position. It is recommended that when the valve is closed it is always at least 1 mm below the top of the valve guard.

If a threaded fixing connection is used, it is recommended to conform to the dimensions given in Figure 4 or Figure 5. The valve guard shall be of such dimensions as not to contact any part of the valve.

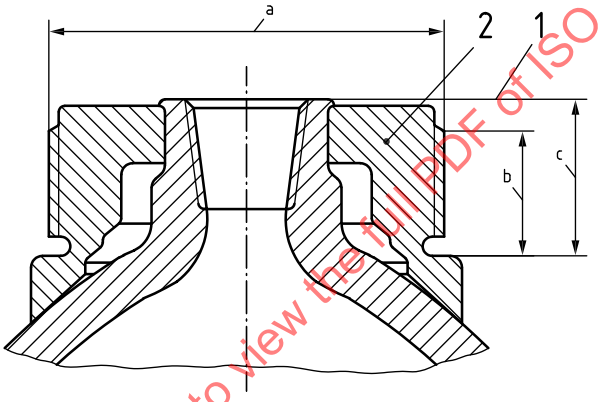
4.3 Cylinder neck ring dimensions

Examples of cylinder neck rings for valve protection caps and valve guards are given in Figure 3.

Dimensions in millimetres



a) Example 1



b) Example 2

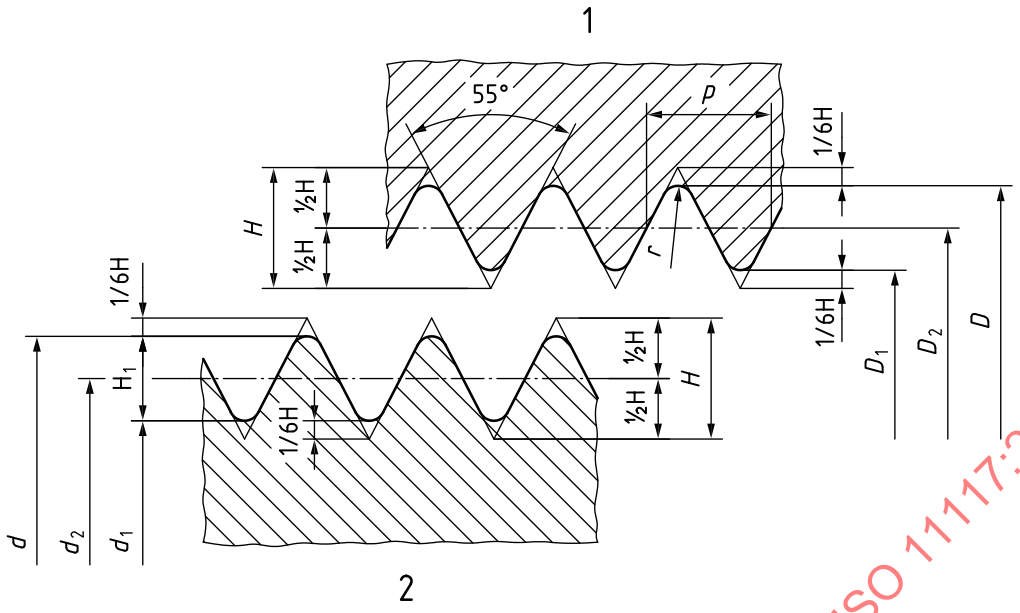
Key

1	reference plane (top of the cylinder)	2	cylinder neck ring
a	W 80 × 1/11.	b	≥16.
c	≤25.		

NOTE The neck rings given in example 1 and 2 are typical for cylinders to which valve protection caps and valve guards are assembled to. Nevertheless, other shapes or dimensions are possible and in use. The 80 mm fixing connection as a commonly used example is shown.

Figure 3 — Examples of cylinder neck rings

Figure 4 in combination with Tables 1 and 2 gives the dimensions of the W 80 × 1/11 thread. Figure 5 in combination with Tables 3 and 4 gives the dimensions of typical North American threads. Other recognized thread forms are permitted, provided all test requirements of this document are met.



Key

1 valve protection cap or valve guard thread profile

2 cylinder neck ring thread profile

$p = \frac{25,4}{z}$

r = 0,137 329 p

H = 0,960 491 p

H_1 = 0,640 327 p

Figure 4 — Dimensions of the W 80 × 1/11 thread

Table 1 — Dimensions of the W 80 × 1/11 thread

Dimensions in millimetres

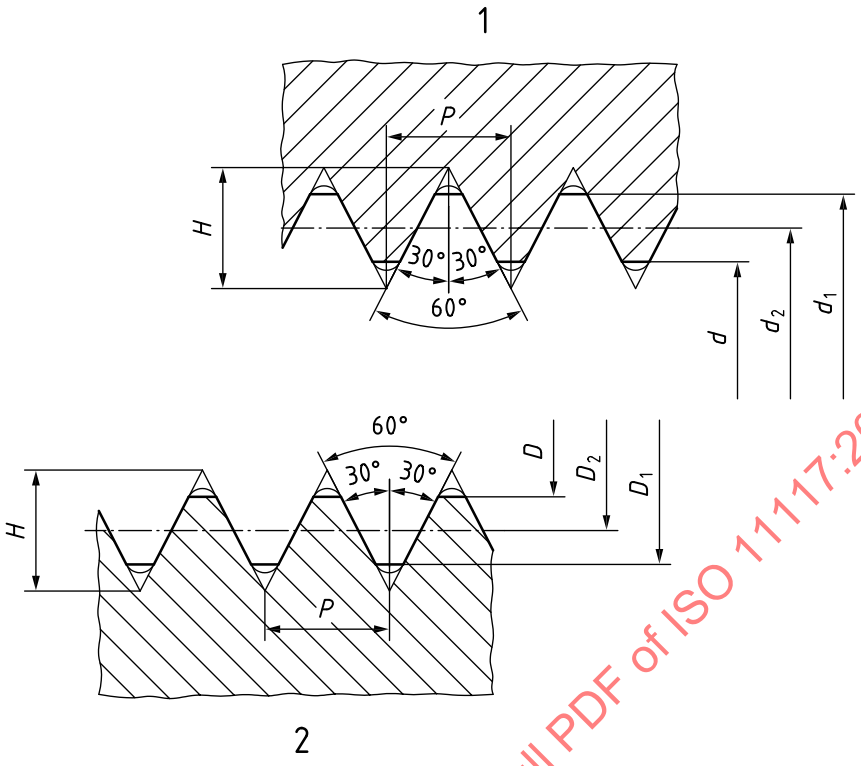
Nominal diameter	Major diameter $d = D$	Pitch diameter $d_2 = D_2$	Minor diameter $d_1 = D_1$	Pitch p	Number of threads per inch z	Thread height H_1	Radius r
W 80	80	78,521	77,042	2,309	11	1,479	0,317

Table 2 — Tolerances of the W 80 × 1/11 thread

Dimensions in millimetres

Nominal diameter	Cylinder neck ring			Valve protection cap or valve guard		
	Major diameter d	Pitch diameter d_2	Minor diameter d_1	Major diameter D	Pitch diameter D_2	Minor diameter D_1
W 80	−0,055 −0,530	0 −0,280	0 −0,450	[a] 0	+0,280 0	+0,630 +0,155

[a] No maximum tolerance is specified but satisfactory operation shall be ensured.



Key

1 valve protection cap or valve guard thread profile

2 cylinder neck ring thread profile

Figure 5 — Dimensions of typical North American threads

Table 3 — Dimensions of typical North American threads

Dimensions in millimetres

Thread	Nominal diameter	Major diameter		Pitch diameter		Minor diameter		Pitch	Number of threads per inch	Thread height
		Cylinder neck ring	Valve protection cap or valve guard	Cylinder neck ring	Valve protection cap or valve guard	Cylinder neck ring	Valve protection cap or valve guard			
		d_1	D_1	d_2	D_2	d	D	p	z	H
$3\frac{1}{8}$×11 UN	79,375	79,197	79,908	77,699	78,410	76,365	77,409	2,309	11	2,000
$3\frac{1}{2}$×11 UN	88,900	88,682	89,065	87,183	87,567	85,849	86,5566	2,309	11	2,000

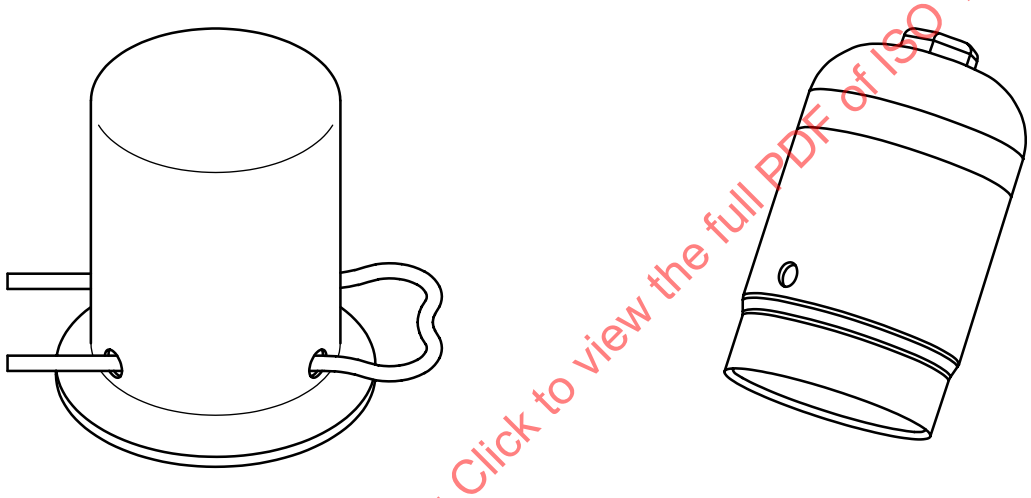
Table 4 — Tolerances of typical North American threads

Dimensions in millimetres

Nominal diameter	Cylinder neck ring			Valve protection cap or valve guard		
	Major diameter d_1	Pitch diameter d_2	Minor diameter d	Major diameter D_1	Pitch diameter D_2	Minor diameter D
$3\frac{1}{8}\times 11$ UN	+0,353 −0,061	+0,101 −0,061	+0,102 −0,061	+0,153 −0,152	+0,152 −0,153	+0,152 −0,152
$3\frac{1}{8}\times 11$ UN	+0,139 +0,111	+0,140 −0,140	+0,140 −0,139	+0,165 −0,165	+0,164 −0,166	+0,174 4 −0,155 6

5 Pictorial examples of valve protection devices

Figure 6 gives examples of valve protection caps and Figure 7 of valve guards.



a) b)

Figure 6 — Examples of valve protection caps

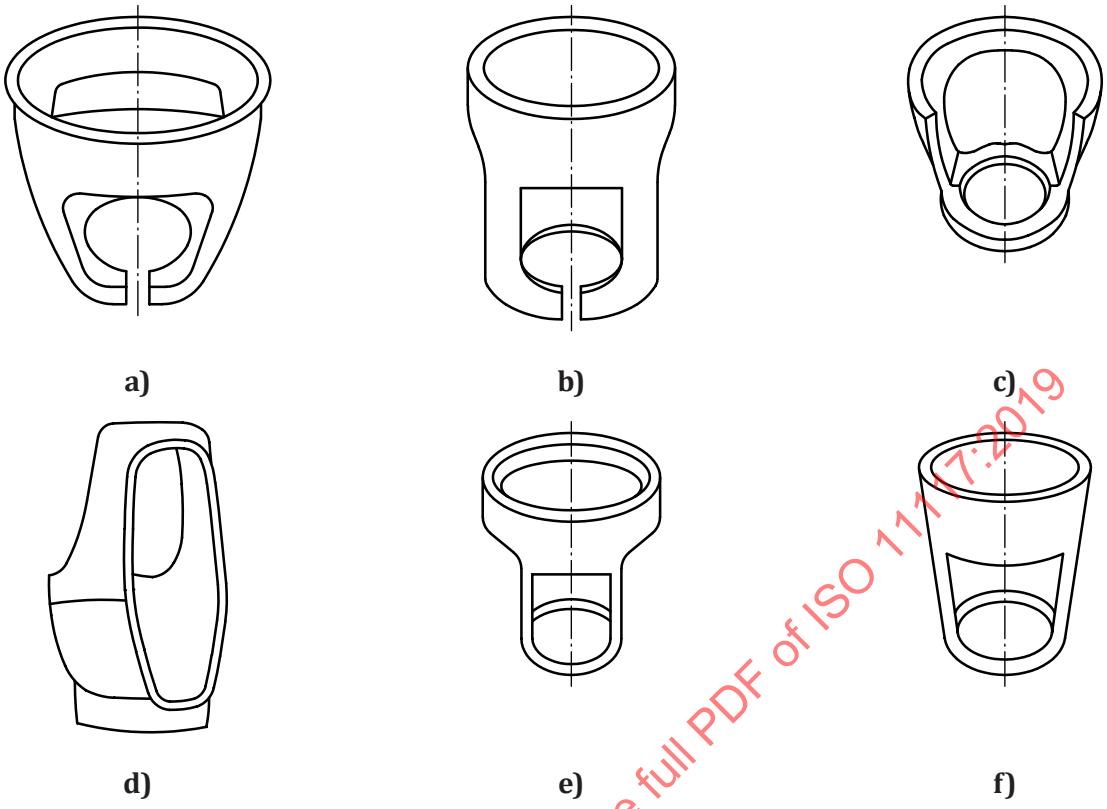


Figure 7 — Examples of valve guards

6 Materials

The relationship between material properties and operating temperatures shall be taken into account. Experience has shown that carrying out tests at –20 °C and room temperature has created safe products.

The manufacturer of a valve protection cap or valve guard shall take into consideration the resistance to the transported product, including solvents [e.g., acetone, dimethylformamide (DMF)], the resistance to atmospheric conditions (e.g., UV for non-metallic valve protection devices) and the operating conditions, if defined by the purchaser. For flammable gases and gas mixtures it could be necessary to use antistatic materials. The manufacturer should also provide information about the expected lifetime.

NOTE Typical materials for valve protection devices are steel, aluminium (both casted and forged) and thermoplastic polymers (also with glass fibre support).

7 Type testing

7.1 General

Tests and examinations performed to demonstrate compliance shall be conducted using instruments calibrated before being put into service and thereafter according to an established programme.

These tests qualify the protection device for use only with valves of maximum dimensions equal to, or less than, that of the test valve, fitted to a cylinder package that is equal to or less than the permitted mass.

The valve protection device shall be fitted according to the manufacturer specification.

Test cylinders for testing valve protection caps and valve guards may be re-used if they show no sign of deformation and the thread connection is not damaged. After completion of testing, the test cylinders shall be rendered unserviceable or shall be clearly marked as test samples to avoid entering into service.

It is recommended to use a new test valve for each single drop test. After completion of testing, the test valves shall be rendered unserviceable or shall be clearly marked as test samples to avoid entering into service.

7.2 Documentation

The manufacturer shall make available to the test laboratory the following documents:

a) a description of the valve protection device (e.g., for valve guards: rotational, or not rotational);

b) the mounting instructions by which the valve protection device is fixed to the cylinder or valve, if applicable;

c) a complete set of drawings (including the bill of material and markings), identifying all dimensions and material specifications (including material datasheet) that are specific for the design of the valve protection device;

d) details of the intended use, including the considerations given to the environmental conditions, the intended valves and the intended cylinders;

e) the principal dimensions of the test valve (see Figure 2), as applicable;

   1) R, r, h, l and L for valve protection caps; or

   2) L and R for valve guards;

f) the valve body material and valve inlet connection of the test valve;

g) information about the cylinder (application, volume, material, dimensions of the neck ring – see item c of Figure 3, if applicable).

The documentation shall indicate the permitted mass.

7.3 Test samples

The number of test samples and the test temperatures for testing a valve protection cap or valve guard is given in Table 5.

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

Table 5 — Test applicability and number of related needed new test samples

Tests (clause)	Test temperatures °C	Valve protection cap	Valve guard
Torque test (7.5)	$\left(20^{+10}_{-5}\right)$	Not applicable	1 for non-rotational valve guards
Vertical pull test (7.6)	$\left(20^{+10}_{-5}\right)$	1 if applicable (see 7.6)	1
Room temperature drop test (7.7)	$\left(20^{+10}_{-5}\right)$	6 to 8	6 to 8
Low temperature drop test (7.7)	$\left(-20^{0}_{-5}\right)$ or at a lower temperature, if specified	2	2

7.4 Preliminary check

The design of the valve protection device shall be checked for conformity with the documentation submitted and with the requirements of Clauses 4 and 6.

7.5 Torque test

Non-rotational metallic valve guards, fixed to the cylinder (i.e., not fixed only to the valve), shall be tested to ensure that an applied torque of at least 70 N·m does not cause the valve guard to rotate.

Non-rotational non-metallic valve guards, fixed to the cylinder (i.e., not fixed only to the valve), shall be tested to ensure that an applied torque of at least 30 N·m does not cause the valve guard to rotate.

7.6 Vertical pull test

This test is only applicable if there is a feasible way to lift the cylinder package via the valve protection device.

NOTE Some valve protection caps widely used on LPG cylinders do not have a feasible way to lift the cylinder.

WARNING — The vertical pull test shall not be interpreted to imply that lifting of cylinders by the valve protection device is an acceptable or safe practice. In such cases, additional precautions shall be taken such as operational instructions or procedures.

The valve protection device shall be tested in the vertical direction, meaning the initial pulling force is applied vertically via a feature of the valve protection device (e.g., handling features).

The cylinder package or head of the cylinder package, both having a test ballast attached, resulting in a total mass of four times the permitted mass, has to be lifted off the ground with sufficient clearance (e.g., 5 cm) for at least 30 s.

If there are multiple handling features, the weakest one shall be tested, if it can be determined. If it cannot be determined, they shall all be tested. The valve protection device shall not separate from the cylinder package through disengagement or fracture.

7.7 Drop test

7.7.1 The valve protection device shall be tested to prove that it functions in such a way that it protects the valve. The test valve shall maintain its operability.

7.7.2 The valve protection device, together with the test valve, shall be fitted to a test cylinder.

The test cylinder shall be representative in terms of application (LPG, other liquefied gas, compressed gas, dissolved gas, refrigerant gas) of the cylinder with which the device is to be used, filled with a quantity of water or other substance appropriate to the test temperature so as to equal the desired permitted mass. If some parts of the cylinder can affect the results of the test (e.g., grips fixed on the cylinder), these parts shall be removed (e.g., by cutting) prior to testing.

The valving procedure shall be such that there is no leakage at the connection to the cylinder prior to conducting the test. Unless specified otherwise, the valving procedure shall follow ISO 13341 by using the minimum relevant specified torque. Before the drop test, the cylinder shall be pressurized to a minimum of 1 bar. For some specific valve designs, e.g., quick-release cylinder valves according to ISO 17871, the minimum pressure shall be chosen to ensure leak tightness of the valve.

In case of a valve protection cap being intended to be "ISO P A" marked (see Clause 8), the dimension *l* according to Figure 2 has to be determined after assembly.

The leak tightness of the valve to cylinder joint shall be verified, for example, by using leak detection spray.