SLOVENSKI PREDSTANDARD

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Premične plinske jeklenke – Specifikacija za zasnovo in konstrukcijo ponovno polnljivih nevarjenih plinskih valjev iz aluminija ali aluminijeve zlitine za prenosne gasilne naprave z ogljikovim dioksidom z vodno prostornino od 0,5 litra do 150 litrov

Transportable gas cylinders - Specification for the design and construction of refillable seamless aluminium or aluminium alloy gas cylinders for portable carbon dioxide fire extinguishers of water capacities from 0,5 litre up to 150 litres

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Transportable gas cylinders - Specification for the design and construction of refillable seamless aluminium or aluminium alloy gas cylinders for portable carbon dioxide fire extinguishers of water capacities from 0,5 litre up to 150 litres

Bouteilles à gaz transportables - Spécifications pour la conception et la fabrication de bouteilles à gaz rechargeables et transportables en aluminium ou alliage d'aluminium sans soudure d'extincteurs d'incedie portatif de dioxide de carbone de capacité de l'eau comprise entre 0,5 litre et 150 litres inclus

Ortsbewegliche Gasflaschen - Gestaltung und Konstruktion von wiederbefüllbaren ortsbeweglichen nahtlosen Gasflaschen aus Aluminium und Aluminiumlegierung für Tragbare Feuerlösche Kohlenstoffdioxid mit einem Fassungsraum von 0,5 Liter bis einschließlich 150 Liter

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 23.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (prEN 15045:2004) has been prepared by Technical Committee CEN/TC 23 “Transportable gas cylinders”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard has been prepared to address the essential requirements of the PED for portable, refillable seamless aluminium CO_2 fire extinguishers of water capacities from 0,5 litre up to and including 15 litres.

Annexes A, B, C and F are normative. Annexes D, E and ZA are informative.

Introduction

The purpose of this standard is to provide a specification for the design, manufacture, inspection and approval of refillable seamless aluminium or aluminium alloy gas cylinders for use in portable CO_2 fire extinguishers.

The specification given is based upon knowledge of, and experience with, materials, design requirements, manufacturing processes and control during manufacture, of cylinders in common use in the countries of the CEN members.

This standard draws upon established practice as outlined in the ADR (European Agreement Concerning the International Carriage of Dangerous Goods by Road) for determining the test pressure of CO_2 cylinders (ADR P200 4.1.4.1)

1 Scope

This standard specifies minimum requirements for the material, design, construction and workmanship, manufacturing processes and tests at manufacture of refillable seamless aluminium or aluminium alloy gas cylinders that are fitted with bursting disc devices for portable CO_2 fire extinguishers of water capacities from 0,5 l up to 15 l.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition*

EN 629-1, *Transportable gas cylinders — 25E taper thread for connection of valves to gas cylinders — Part 1: Specification*

EN 629-2, *Transportable gas cylinders — 25E taper thread for connection of valves to gas cylinders — Part 2: Gauge inspection*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10003-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

EN 10204, *Metallic Products — Types of inspection documents*

EN ISO 7539-6, *Corrosion of metals and alloys — Stress corrosion testing — Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement (ISO 7539-6:1989)*

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

EURONORM 6-55, *Bend test for steel*

prEN ISO 13769: 2004, *Gas cylinders — Stamp marking (ISO 13769:2002)*

EN ISO 15245-1, *Gas cylinders — Parallel threads for connection of valves to gas cylinders — Part 1: Specification*

EN ISO 15245-2, *Gas cylinders — Parallel threads for connection of valves to gas cylinders — Part 2: Gauge Inspection*

3 Terms, definitions and symbols

For the purpose of this document, the terms, definitions and symbols given in EN ISO 7539-6:1995 and the following apply.

3.1 Terms and definitions

3.1.1
artificial ageing
heat treatment process in which the solute phase is precipitated to give an increased yield stress and tensile strength

3.1.2
batch
quantity of up to 500 cylinders, plus cylinders for destructive testing, of the nominal diameter, thickness, length and design made successively from the same cast and (if applicable) the same artificial ageing furnace load

3.1.3
crack mouth opening displacement (CMOD)
V
mode 1 (also called opening-mode) component of crack displacement due to elastic and plastic deformation, measured at the location on a crack surface that has the greatest elastic displacement per unit load

3.1.4
design stress factor (variable)
F
ratio of equivalent wall stress at test pressure (P_h) to guaranteed minimum yield stress (R_e)

3.1.5
mass
weight of a cylinder, expressed in kilograms, comprising the combined weight of cylinder and permanently attached parts (eg foot ring, neck ring) but without valve

3.1.6
quenching
controlled rapid cooling in a suitable medium to retain the solute phase in solid solution

3.1.7
solution heat treatment
thermal treatment which consists of heating the products to a suitable temperature, holding at that temperature long enough to allow constituents to enter into solid solution and cooling rapidly enough to hold the constituents in solution

3.1.8
stabilizing heat treatment
heat treatment applied to some 5000 series aluminium alloys in order to prevent changes in mechanical properties and structure under service conditions

3.1.9
yield stress
value corresponding to 0,2 % proof stress (non-proportional elongation), $R_{p0,2}$ for aluminium alloys, or 1% proof stress for unalloyed aluminium in the unhardened state

3.2 Symbols

a Calculated minimum thickness, in millimetres, of the cylindrical shell

a' Guaranteed minimum thickness, in millimetres, of the cylindrical shell

A Percentage elongation, determined by the tensile test **8.2.2.2**

b Guaranteed minimum thickness, in millimetres, at the centre of a convex base (see Figure 1)

d Diameter of former, in millimetres (see Figure 4)

D Nominal outside diameter of the cylinder, in millimetres (see Figure 1)

E Modulus of elasticity, in megapascals (MPa)

F Design stress factor (variable) (see **3.1.4**)

H Outside height of domed part (convex head or base end), in millimetres (see Figure 1)

K_{IAPP} Applied elastic stress intensity, in MPa×m ^{½}

n The ratio of the diameter of the bend test former to actual thickness of test piece (t)

P_b Measured burst pressure, in bar[1)] above atmospheric pressure

P_{lc} Lower cyclic pressure, in bar[1)] above atmospheric pressure

P_h Hydraulic test pressure, in bar[1)] above atmospheric pressure

P_S Maximum allowable pressure in bar for which the cylinder is designed, as specified in **5.2**

r Inside knuckle radius, in millimetres (see Figure 1)

r_i Inside crown radius, in millimetres (see Figure 1)

R_e Minimum guaranteed value of yield stress (see **3.1.9**) in megapascals, for the finished cylinder

R_{ea} Actual value of yield stress, in megapascals, determined by the tensile test in **8.1.2**

R_{eSLC} Average of measured yield stress of two specimens from the test cylinder representing the SLC test specimens location at room temperature, in megapascals (for location of the specimens, see **B.4.3**)

R_g Minimum guaranteed value of tensile strength, in megapascals, for the finished cylinder

R_m Actual value of tensile strength, in megapascals, determined by the tensile test in **8.1.2**

S_o Original cross sectional area of tensile test piece, in square millimetres, according to EN 10002-1

SLC Sustained-load-cracking

T Titre

T_s Maximum allowable temperature, in degree Celsius (°C)

t Actual thickness of test specimen, in millimetres

V Crack mouth opening displacement (CMOD), in millimetres

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1) 1bar = 10^5 Pa = 0.1MPa.

4 Material requirements

4.1 General provisions

4.1.1 Cylinders for portable CO_2 fire extinguishers may be manufactured from unalloyed aluminium of at least 99,5% purity.

4.1.2 Aluminium alloy(s) that conform to EN 573-3 (or Aluminum Association[1)] documents) as listed in Table 1 may be used to produce portable CO_2 fire extinguisher cylinders, provided that they satisfy the requirements of the corrosion resistance tests defined in annex A, and meet all other requirements of this standard including annex B. For specific requirements relating to Aluminium Alloy 2001, refer to annex F.

4.1.3 The cylinder manufacturer shall permanently mark the cylinders with the particular cast of the alloy from which they are made, and shall obtain documentation prepared by the material manufacturer that affirms conformity to the specified material. This documentation shall take the form of a certificate of specific product control (EN 10204).

4.2 Heat treatment

4.2.1 Heat-treatable alloys

The manufacturer shall specify on the new design (type) approval documentation the solution heat treatment and artificial ageing temperatures and the times for which the cylinders have been held at those temperatures. The medium used for quenching after solution heat treatment shall be identified.

4.2.2 Non-heat-treatable alloys

The manufacturer shall specify on the new design (type) approval documentation the type of metal forming operation carried out (extrusion, drawing, ironing, head forming, etc).

Unless the alloy is subjected to a temperature in excess of 400°C during the forming process, a stabilizing heat treatment shall be carried out and the temperature and time at temperature shall be specified by the manufacturer.

4.2.3 Control of specified heat treatment

During the heat treatment, the manufacturer shall comply with the specified temperatures and durations, within the following tolerances.

a) Temperatures:

— solution temperature ± 10 °C;

— artificial ageing temperature ± 5 °C;

— stabilizing temperature ± 10 °C.

b) Durations:

— stabilizing treatment ± 10%.

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2) AA is the Aluminum Association Inc., 900 19th Street N.W.,Washington D.C., 20006-2168, USA.

Table 1 — Chemical composition of aluminium alloys

Type of alloy[a]	Marking code reference		Chemical composition weight %												
			Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Zr	Pb	Others	Aluminium
														Each / Total	
EN AW-5283A	5283	min	-	-	-	0,50	4,5	-	-	-	-	-	-	- / -	Remainder
		max	0,30	0,30	0,03	1,0	5,1	0,05	0,03	0,10	0,03	0,05	0,0030	0,05 / 0,15	
EN AW-6061A	6061	min	0,40	-	0,15	-	0,8	0,04	-	-	-	-	-	- / -	Remainder
		max	0,8	0,7	0,40	0,15	1,2	0,35	-	0,25	0,15	-	0,0030	0,05 / 0,15	
EN AW-2001	2001	min	-	-	5,2	0,15	0,2	-	-	-	-	-	-	- / -	Remainder
		max	0,20	0,20	6,0	0,5	0,45	0,10	0,05	0,10	0,20	0,05	0,0030	0,05 / 0,15	
EN AW-7060	7060	min	-	-	1,8	-	1,3	0,15	-	6,1	-	-	-	- / -	Remainder
		max	0,15	0,20	2,6	0,20	2,1	0,25	-	7,5	0,05	0,05	0,0030	0,05 / 0,15	
AA-7032[b]	7032	min	-	-	1,8	-	1,7	0,15	-	5,6	-	-	-	- / -	Remainder
		max	0,1	0,12	2,4	0,05	2,5	0,25	-	6,6	0,1	0,05	0,0030	0,05 / 0,15	

[2)] Where a melt contains scrap or other re-used material the bismuth content shall not exceed 0,0030 %.

[a] Alloy designation according to EN 573-3.

[b] AA is the Aluminum Association Inc., 900 19th Street N.W., Washington D.C., 20006-2168, USA. AA 7032 is awaiting inclusion in EN 573-3.

5 Design requirements

5.1 General provisions for heat-treatable alloys

5.1.1 The calculation of the wall thickness of the pressure-containing parts shall be related to the yield stress (R_e) of the material to ensure elastic behaviour.

5.1.2 For calculation purposes the value of the yield stress (R_e) is limited to a maximum of 0,90 R_g for aluminium alloys.

5.1.3 The internal pressure upon which the calculation of wall thickness is based shall be the hydraulic test pressure (p_h).

5.2 Calculation of cylindrical wall thickness for heat-treatable alloys

The guaranteed minimum thickness of the cylindrical shell (a') shall not be less than the thickness calculated using the equation:

$$a = \frac{D}{2}\left(1 - \sqrt{\frac{10FR_e - \sqrt{3}.p_h}{10FR_e}}\right)$$

where the value of F shall not exceed 0,875.

The calculated minimum thickness shall also satisfy the equation:

$$a \geq \frac{D}{100} + 1$$

where the value of a shall be at least 1,5 mm.

Cylinders for CO_2 fire extinguishers shall be designed using hydraulic test pressures related to selected filling ratios. The test pressure shall not be less than the developed pressure at 65°C (see Table 2).

Table 2 — Test pressure versus filling ratio

Filling ratio kg/l	**Maximum allowable pressure** P_S bar	**Minimum test pressure** P_h bar
0,667	136,8	200
0,675	138,4	200
0,750	173,5	250

When choosing the minimum guaranteed value of the thickness of the cylindrical shell (a'), the manufacturer shall take into account all requirements for type and production testing, particularly the burst test requirements of **8.2**.

NOTE For examples of wall thickness calculations, see annex D.

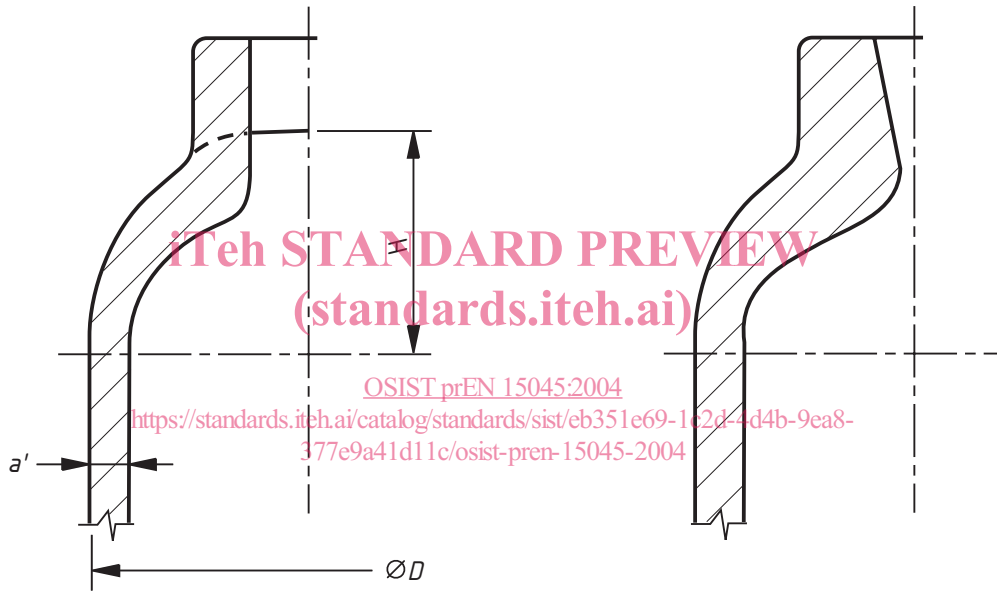
5.3 Design of ends (heads and bases)

The thickness and shape of the base and head of the cylinders shall be such as to meet the requirements of the tests laid down in **8.3** and **8.4**

In order to achieve satisfactory stress distribution, the cylinder wall thickness shall increase progressively in the transition zone between the cylindrical shell and the ends, particularly the base end. For example, typical shapes of convex heads and base ends are shown in Figure 1. The thickness at any part of the base shall not be less than the guaranteed minimum thickness of the cylindrical part.

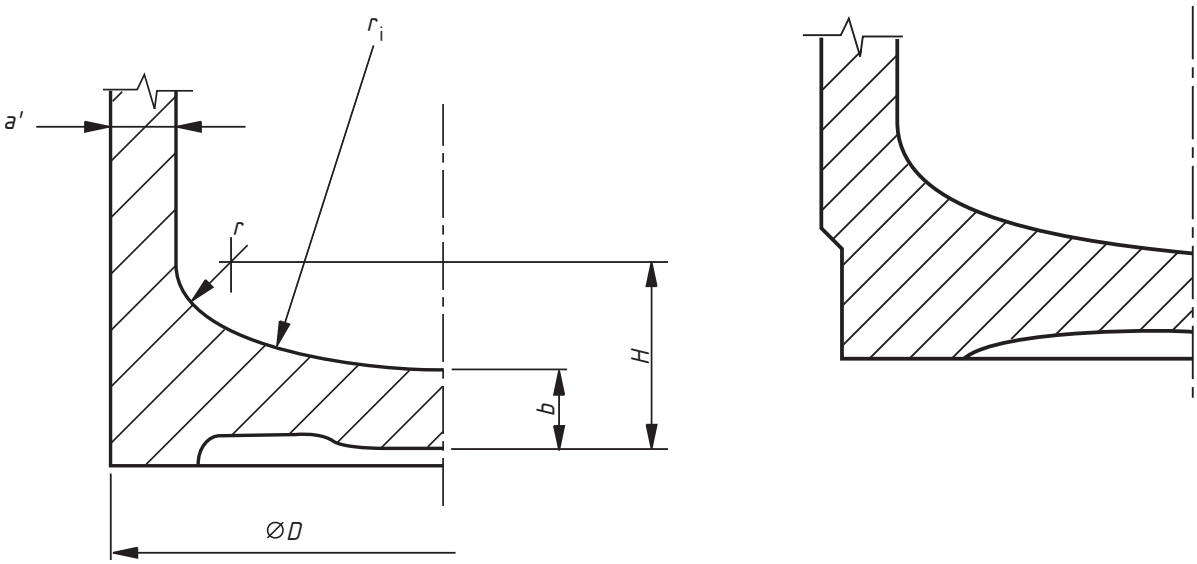
The internal knuckle radius (r) shall not be less than 10 % of the internal diameter of the shell.

For convex ends, the inside crown radius (r_i) shall not be greater than 1,2 times the internal diameter of the shell.



a) b)

Figure 1 — Examples of convex ends



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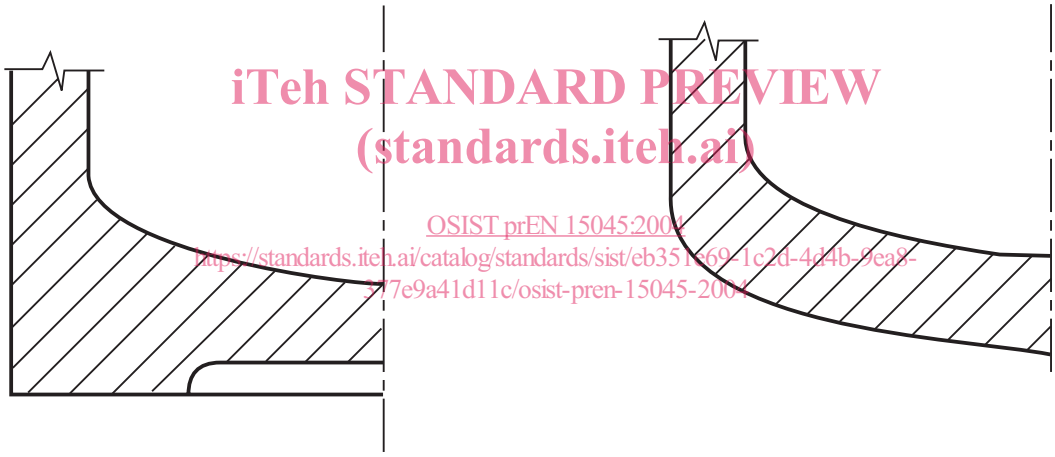

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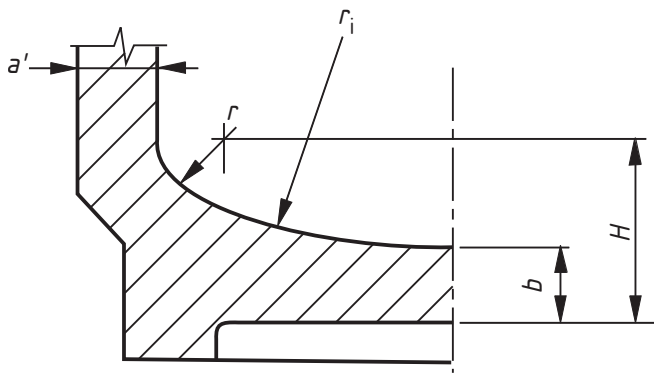

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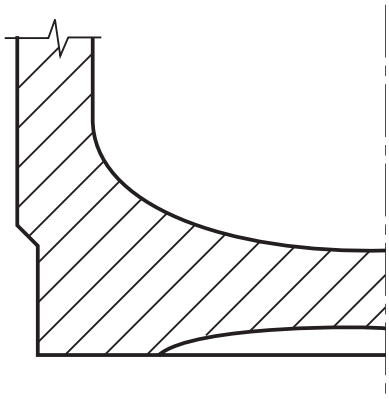
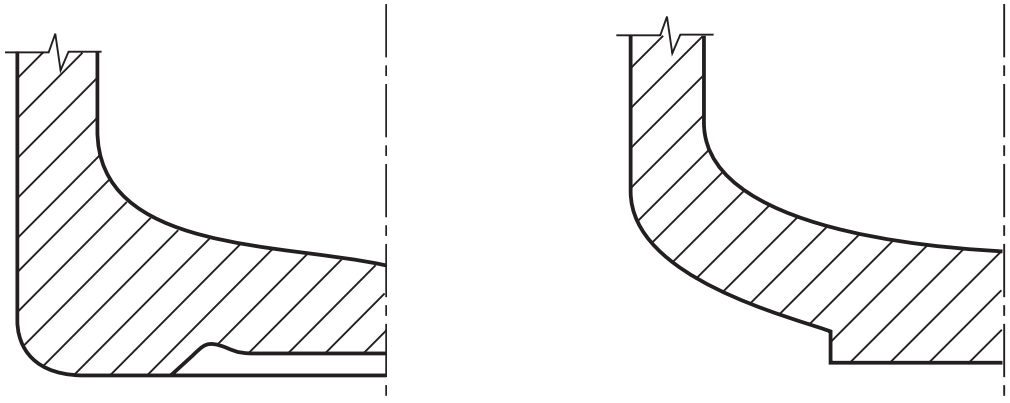
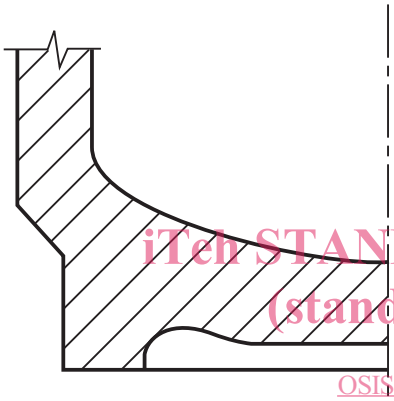


h)

Figure 1 — Examples of heads and convex ends (cont.)



i) j)



k)

Figure 1 — Examples of heads and convex ends (cont.)

5.4 Neck design

5.4.1 The external diameter and thickness of the formed neck end of the cylinder shall be adequate for the torque applied in fitting the valve to the cylinder. The torque may vary according to the diameter of thread, the form, and the sealant used in the fitting of the valve. The torques specified in EN ISO 13341 shall not be exceeded, since this could result in permanent damage to the cylinder. Where the cylinder manufacturer specifies a lower torque this also shall not be exceeded. The manufacturer shall notify any such requirements to the purchaser of aluminium or aluminium alloy cylinders for portable CO_2 fire extinguishers.

5.4.2 The thickness of the wall in the cylinder neck shall be sufficient to prevent permanent expansion of the neck during initial and subsequent fitting of the valve into the cylinder. Where the cylinder is specifically designed to be fitted with neck reinforcement, such as a neck ring or shrunk-on collar this may be taken into account (see EN ISO 13341).

5.4.3 Cylinders for portable CO_2 fire extinguishers may be designed with one or two opening(s) along the central cylinder axis only.