SLOVENSKI STANDARD
SIST EN 1975:1999

01-september-1999

Premiļ ne plinske jeklenke - Specifikacije za zasnovo in izdelavo ponovno polnljivih plinskih jeklenk iz celega iz aluminija in aluminijeve zlitine s prostornino od 0,5 do vkljuļ no 150 litrov

Transportable gas cylinders - Specification for the design and construction of refillable transportable seamless aluminium and aluminium alloy gas cylinders of capacity from 0,5 litre up to 150 litres

Ortsbewegliche Gasflaschen - Gestaltung und Konstruktion von wiederbefüllbaren ortsbeweglichen nahtlosen Gasflaschen aus Aluminium und Aluminiumlegierung mit einem Fassungsraum von 0,5 l bis einschließlich 150 l.

Bouteilles a gaz transportables - Spécifications pour la conception et la fabrication de bouteilles a gaz rechargeables et transportables en aluminium et alliage d'aluminium sans soudure de capacité comprise entre 0,5 l et 150 l inclus

Ta slovenski standard je istoveten z: **EN 1975:1999**

ICS:

23.020.30	Tlaļ ne posode, plinske jeklenke	Pressure vessels, gas cylinders

SIST EN 1975:1999 **en**

EUROPEAN STANDARD

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EN 1975

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English version

Transportable gas cylinders - Specification for the design and construction of refillable transportable seamless aluminium and aluminium alloy gas cylinders of capacity from 0,5 litre up to 150 litre

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This European Standard was approved by CEN on 20 December 1998.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1975:1999 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 023 "Transportable gas cylinders", the secretariat of which is held by BSI.

This European Standard replaces EN 1975:1999..

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The purpose of this standard is to provide a specification for the design, manufacture, inspection and approval of refillable transportable seamless aluminium and aluminium alloy gas cylinders. The specifications given are based on 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.

1 Scope

This standard specifies minimum requirements for the material, design, construction and workmanship, manufacturing processes and tests at manufacture of refillable transportable seamless aluminium and aluminium alloy gas cylinders of water capacities from 0,5 l up to and including 150 l for compressed, liquefied and dissolved gases.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 962:1996	Transportable gas cylinders - Valve protection caps and valve guards for industrial and medical gas cylinders - Design, construction and tests
EN 1089-1:1996	Transportable gas cylinders - Gas cylinder identification - Part 1: Stampmarking
EN 10002-1	Metallic materials - Tensile testing - Part 1: Method of test
EN 10003-1	Metallic materials - Brinell hardness test - Part 1: Test method
EN ISO 13341	Transportable gas cylinders - Fitting of valves to gas cylinders
EURONORM 6-55	Bend test for steel
EURONORM 12-55	Bend test of sheet steels and strips with a thickness of less than 3 mm
EN ISO 7539-6: 1995	Corrosion of metals and alloys - Stress corrosion testing - Part 6: Preparation and use of pre-cracked specimens (ISO 7539-6: 1989)

3 Definitions and symbols

For the purposes of this standard the following definitions and symbols apply.

3.1 Definitions

3.1.1 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.

3.1.2 solution heat treatment: A 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.

3.1.3 quenching: Controlled rapid cooling in a suitable medium to retain the solute phase in solid solution.

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

3.1.5 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.

3.1.6 batch: A quantity of up to 200 cylinders, plus cylinders for destructive testing, of the same nominal diameter, thickness, length and design, made successively from the same cast and subjected to the same heat treatment for the same duration of time.

3.1.7 mass: The mass of a cylinder, expressed in kilogrammes, comprising the combined mass of cylinder and permanently attached parts (e.g. foot ring, neck ring, etc.) but without valve.

3.1.8 design stress factor (F) (variable): The ratio of equivalent wall stress at test pressure (p_h) to guaranteed minimum yield stress (R_e).

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 7.1.2.1

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

d Diameter of former, in millimetres (see figure 5)

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

F Design stress factor (variable) (see 3.1.8)

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

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_y Observed yield pressure, in bar[1)] above atmospheric pressure

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 3.1.1), in megapascals, for the finished cylinder

R_{ea} Actual value of yield stress, in megapascals, determined by the tensile test 7.1.2.1

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 7.1.2.1

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

t Actual thickness of test specimen, in millimetres

4 Materials

4.1 General provisions

4.1.1 Gas cylinders may be manufactured from unalloyed aluminium of at least 99,5 % purity.

4.1.2 Aluminium alloy(s) may be used to produce gas cylinders provided that they satisfy the requirements of the corrosion resistance tests defined in annex A, meet all other requirements of this standard including annex B and are approved by the relevant Authority.

The alloys most commonly used for the fabrication of gas cylinders are those given in table 1.

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1) 1 bar = 10^5 Pa = 0,1 MPa.

4.1.3 The cylinder manufacturer shall identify the cylinders with the particular casts of the alloy from which they are made, and shall obtain and provide certificates of the analyses of the casts used.

4.2 Heat treatment

4.2.1 *Heat treatable alloys*

The manufacturer shall specify on the prototype testing 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 prototype testing 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 identified 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

Time cylinders actually spend at temperature during treatments

Solution treatment	± 30 %
Ageing treatment	± 20 %
Stabilizing treatment	± 10 %

Table 1: Chemical composition of aluminium alloys

Type of alloy AA[1)] registered designation	Marking code reference		Chemical composition - weight %													
			Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Zr	Pb	Others Each	Others Total	Aluminium
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	
6061 A	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	
6082 A	6082	min	0,7	-	-	0,40	0,60	-	-	-	-	-	-	-	-	Remainder
		max	1,3	0,50	0,10	1,0	1,2	0,25	-	0,20	0,10	-	0,0030	0,05	0,15	
6351 A	6351	min	0,7	-	-	0,40	0,40	-	-	-	-	-	-	-	-	Remainder
		max	1,3	0,50	0,10	0,8	0,8	-	-	0,20	0,20	-	0,0030	0,05	0,15	
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	

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

NOTE: Where a melt contains scrap or other re-used material the bismuth content shall not exceed 0,0030 %.

5 Design

5.1 General provisions

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).

5.1.4 For dissolved acetylene, the manufacturing process of the porous mass can modify the characteristics of the aluminium alloy used. This shall be considered when designing the shell.

5.2 Calculation of cylindrical wall thickness

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

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

where the value of F is the lesser of $\frac{0,65}{(R_e / R_g)}$ or 0,77.

R_e/R_g shall be limited to 0,90.

The calculated minimum thickness shall also satisfy the equation:

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

with an absolute minimum of a = 1,5 mm.

When choosing the minimum guaranteed value of the thickness of the cylindrical shell (a'), the manufacturer shall take into account all requirements for prototype and production testing, particularly the burst and yield pressure test requirements of 7.2.2.2.

For examples of wall thickness calculations see annex E.

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 7.2 and 7.3.

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

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

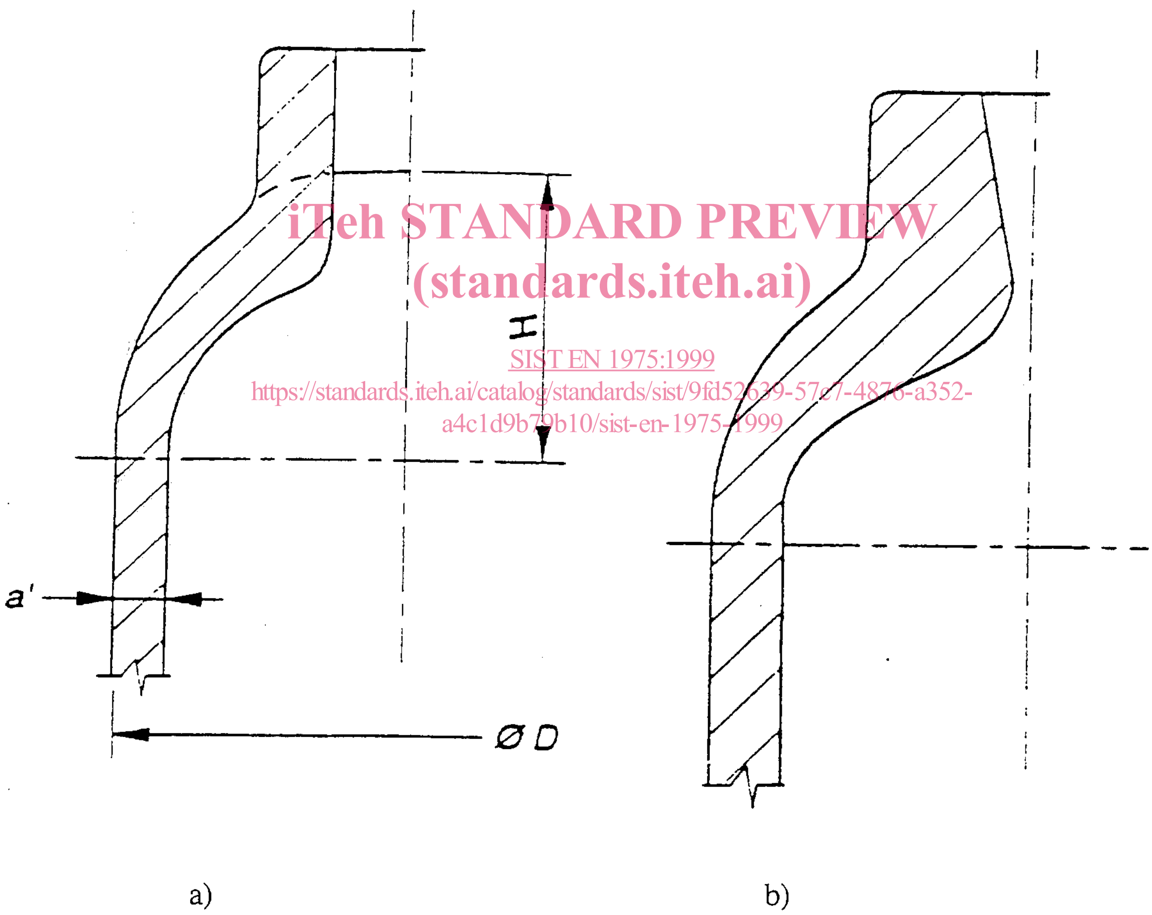
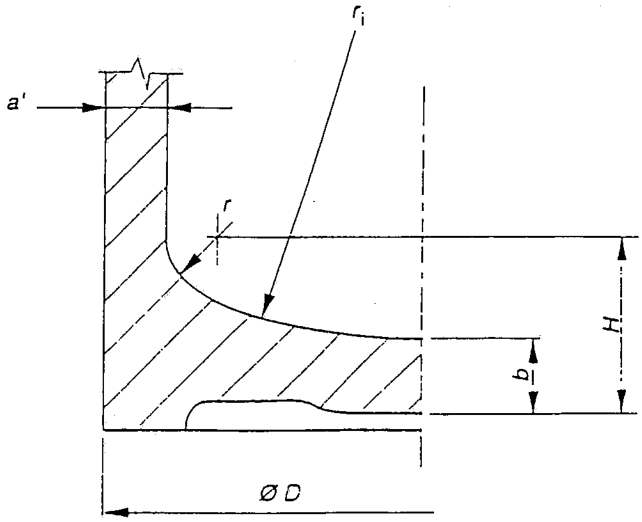


Figure 1: Examples of convex ends



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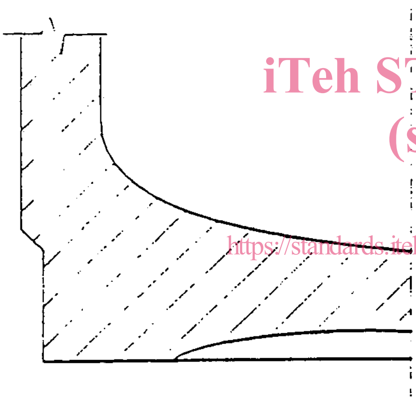

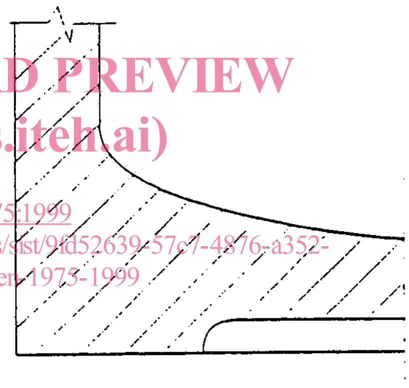

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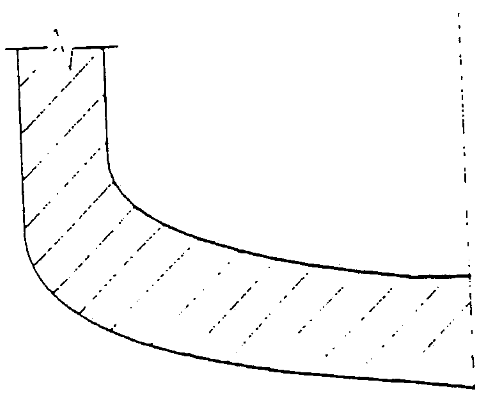

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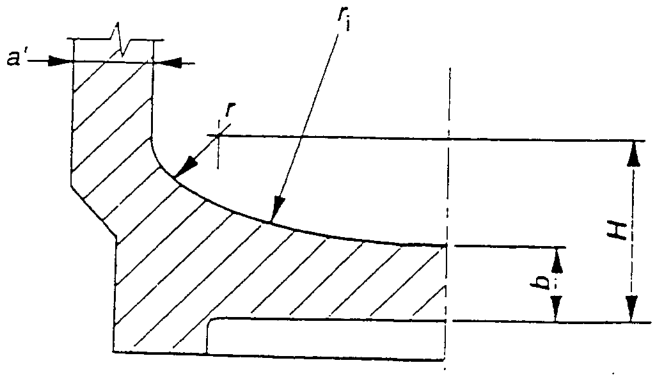
Figure 1: Examples of convex ends (Cont'd)



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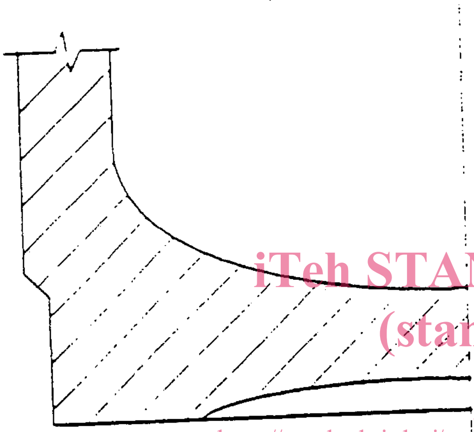
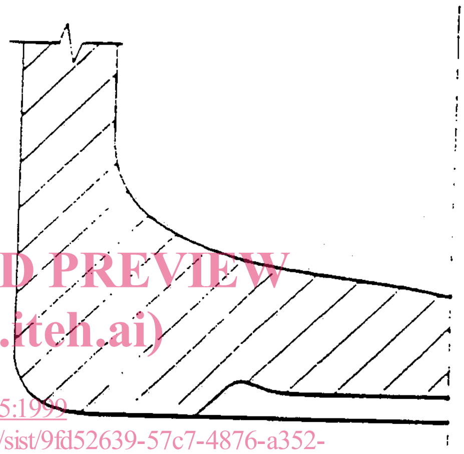
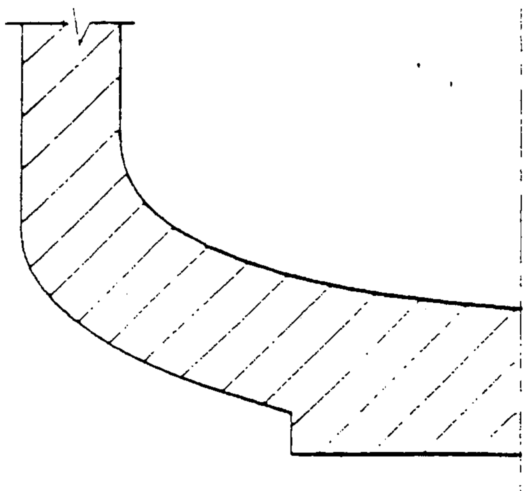
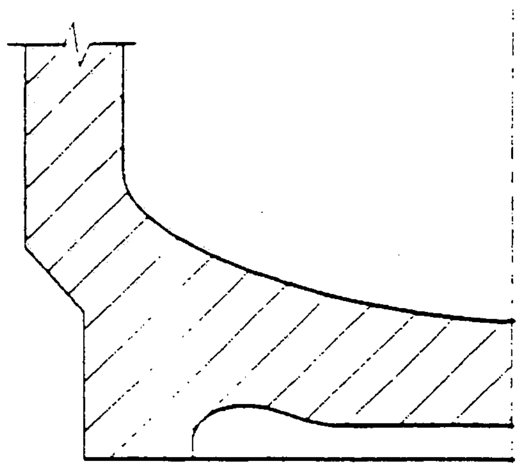




h) i)





j) k)

Figure 1: Examples of convex ends (concluded)