



SLOVENSKI STANDARD

SIST EN 13110:2003

01-december-2003

Premične ponovno polnljive varjene aluminijeve jeklenke za utekočinjeni naftni plin (UNP) - Načrtovanje in izdelava

Transportable refillable welded aluminium cylinders for liquefied petroleum gas (LPG) - Design and construction

Ortsbewegliche, wieder befüllbare geschweißte Flaschen aus Aluminium für Flüssiggas (LPG) - Gestaltung und Konstruktion

Bouteilles soudées transportables et rechargeables en aluminium pour gaz de pétrole liquéfié - Conception et construction

[SIST EN 13110:2003](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)

[https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)

[c961637fe394/sist-en-13110-2003](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)

Ta slovenski standard je istoveten z: EN 13110:2002

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders
77.150.10	Aluminijski izdelki	Aluminium products

SIST EN 13110:2003

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 13110:2003

<https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003>

EUROPEAN STANDARD

EN 13110

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2002

ICS 23.020.30

English version

Transportable refillable welded aluminium cylinders for liquefied petroleum gas (LPG) - Design and construction

Bouteilles soudées transportables et rechargeables en aluminium pour gaz de pétrole liquéfiés - Conception et construction

Ortsbewegliche, wieder befüllbare geschweißte Flaschen aus Aluminium für Flüssiggas (LPG) - Gestaltung und Konstruktion

This European Standard was approved by CEN on 9 September 2002.

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 Management Centre 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

[SIST EN 13110:2003](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)

<https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003>



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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

	page
Foreword.....	4
Introduction	5
1 Scope	5
2 Normative references	5
3 Terms, definitions and symbols	6
3.1 Terms and definitions.....	6
3.2 Symbols	6
4 Materials.....	7
5 Design	8
5.1 General requirements.....	8
5.2 Calculation of cylindrical wall thickness.....	8
5.3 Design of ends concave to pressure	8
5.4 Other shapes of ends	12
5.5 Minimum wall thickness.....	13
5.6 Design of openings.....	13
5.7 Neck design	13
5.8 Stability	13
5.9 Valve protection	13
6 Construction and workmanship.....	13
6.1 Welding qualification	13
6.2 Plates and pressed parts	14
6.3 Welded joints.....	14
6.4 Tolerances	14
6.4.1 Out of roundness	14
6.4.2 Wall thickness	14
6.4.3 Straightness	14
6.4.4 Verticality	14
6.5 Non pressure bearing attachments.....	14
6.6 Heat treatment.....	15
6.7 Closure of openings	15
7 Testing and examination	15
7.1 General.....	15
7.2 Destructive tests	15
7.2.1 Mechanical tests	15
7.2.2 Burst test under hydraulic pressure	20
7.2.3 Fatigue test	20
7.2.4 Drop test	21
7.3 Non-destructive testing.....	21
7.3.1 Visual examination of the surface of the weld.....	21
7.3.2 Radiographic examination	21
7.3.3 Pressure test	23
7.4 Machine reproducibility test	23
8 Acceptance procedure	23
8.1 General.....	23
8.2 Batch testing	23
8.2.1 Batch	23
8.2.2 Inspection lots.....	24

8.2.3	Rate of testing	24
8.3	Failure to meet batch test requirements	25
9	Technical requirements for type approval	26
9.1	New cylinder design	26
9.2	Type approval tests	26
10	Marking	26
11	Certificate	27
Annex A (normative) Manufacturers marking		28
Annex B (normative) Corrosion tests		29
B.1	Test for assessing susceptibility to intercrystalline corrosion	29
B.1.1	Specimens	29
B.1.2	Pre-treatment of the specimen before corrosive etching.....	29
B.1.3	Corrosive etching process	30
B.1.4	Preparation of specimens for examination.....	30
B.1.5	Micrographic examination of specimens	31
B.1.6	Interpretation of the micrographic examination.....	31
B.2	Tests for assessing susceptibility to stress corrosion	33
B.2.1	Specimens	33
B.2.2	Surface preparation before test	34
B.2.3	Method	34
B.2.4	Interpretation of the results	35
B.2.5	Metallographical examination (additional examination).....	35
B.3	Conclusion of corrosion tests.....	36
B.4	Test report	36
Bibliography		37

[SIST EN 13110:2003](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)
<https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003>

EN 13110:2002 (E)**Foreword**

This document (EN 13110:2002) has been prepared by Technical Committee CEN/TC 286 "Liquefied petroleum gas equipment and accessories", the secretariat of which is held by NSAI.

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 May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

The standard has been submitted for reference into the RID and/or in the technical annexes of ADR.

Therefore in this context the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present standard are normative only when the standard themselves are referred to in the RID and/or in the technical annexes of the ADR.

Annexes A and B are normative.

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 13110:2003](https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003)

<https://standards.iteh.ai/catalog/standards/sist/162e99b3-318a-49d5-9a58-c961637fe394/sist-en-13110-2003>

Introduction

This European Standard calls for the use of substances and procedures that might be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

It has been assumed in the drafting of this European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

1 Scope

This European Standard specifies minimum requirements for material, design, construction and workmanship, testing and examination during the manufacture of transportable refillable welded aluminium liquefied petroleum gas (LPG) cylinders having a water capacity from 0,5 l up to and including 150 l, exposed to ambient temperature.

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 (including amendments).

[SIST EN 13110:2003](#)

EN 287-2, *Approval testing of welders – Fusion welding – Part 2: Aluminium and aluminium alloys.*

[c961637e394/sist-en-13110-2003](#)

EN 288-1, *Specification and approval of welding procedures for metallic materials – Part 1: General rules for fusion welding.*

EN 288-2, *Specification and approval of welding procedures for metallic materials – Part 2: Welding procedure specifications for arc welding.*

EN 288-4, *Specification and approval of welding procedures for metallic materials – Part 4: Welding procedure tests for the arc welding of aluminium and its alloys.*

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

EN 719, *Welding coordination – Tasks and responsibilities.*

EN 876, *Destructive tests on welds in metallic materials – Longitudinal tensile test on weld metal in fusion welded joints.*

EN 895, *Destructive tests on welds in metallic materials – Transversal tensile test.*

EN 910, *Destructive tests on welds in metallic materials – Bend tests.*

EN 970, *Non-destructive examination of fusion welds – Visual examination.*

EN 1321, *Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds.*

EN 1418, *Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanised and automatic welding of metallic materials.*

EN 13110:2002 (E)

EN 1435, *Non-destructive examination of welds – Radiographic examination of welded joints.*

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

EN 10204, *Metallic products – Types of inspection documents.*

EN 30042, *Arc-welded joints in aluminium and its weldable alloys – Guidance on quality levels for imperfections (ISO 10042:1992).*

EN ISO 11114-1, *Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 1: Metallic materials (ISO 11114-1:1997).*

EN ISO 11116-1, *Gas cylinders – 17E taper thread for connection of valves to gas cylinders – Part 1: Specifications (ISO 11116-1:1999).*

3 Terms, definitions and symbols**3.1 Terms and definitions**

For the purposes of this European Standard, the following terms and definitions apply.

3.1.1**yield stress**

0,2 % proof stress $R_{p0,2}$ (non proportional elongation) for aluminium alloys, and the 1 % proof stress for unalloyed aluminium in the unhardened state

3.1.2**heat treatment**

solution heat treatment, quenching and artificial or natural ageing that ensures the strength values required

3.2 Symbols

- a* Calculated minimum thickness of the cylindrical part, in mm.
- A* Actual elongation after fracture, determined by the tensile test specified in 7.2, in %.
- A_{\min} Minimum elongation after fracture, guaranteed by the manufacturer for the finished cylinder, in %.
- b* Calculated minimum thickness of the end of the cylinder, in mm.
- C* Shape factor (see Table 2 and Figure 2 and Figure 3).
- d* Outside diameter of the bend test former, in mm (see Figure 6).
- D* Outside diameter of the cylinder as given in the design drawing, in mm (see Figure 1).
- h* Height of the cylindrical part of the end, in mm (see Figure 1).
- H* Outside height of the domed part of the end, in mm (see Figure 1).
- L* Length of the cylinder, in mm.
- n* Ratio of diameter of bend test former to the thickness of the test piece (see Table 4).

- P_b Maximum pressure attained during the burst test, in bar.
- P_h Minimum permissible test pressure, in bar above atmospheric pressure.
- r Inside knuckle radius of the end, in mm (see Figure 1).
- R Inside dishing radius of the end, in mm (see Figure 1).
- R_e Minimum value of yield stress, guaranteed by the manufacturer for the finished cylinder, in N/mm^2 .
- R_g Minimum value of tensile strength, guaranteed by the manufacturer for the finished cylinder, in N/mm^2 .
- R_m Actual value of tensile strength, determined by the tensile test specified in 7.2, in N/mm^2 .
- $R_{p0,2}$ Actual value of yield stress, determined by the tensile test specified in 7.2, in N/mm^2 .
- v Utilisation factor for the permissible calculation tension (stress reduction factor).

4 Materials

4.1 Except as permitted in 4.2, the alloys used shall be in accordance with Table 1:

(standards.iteh.ai)

Table 1 — Cast analysis

Element	Material designation		
	AlMgSi1	AlMg1Si1	AlMgSi0,5
	Chemical composition		
Silicon %	0,7 – 1,3	1,2 – 1,6	0,3 – 0,6
Iron %	0,5 max.	0,5 max.	0,1 – 0,3
Copper %	0,1 max.	0,1 max.	0,1 max.
Manganese %	0,4 – 1,0	0,8 – 1,0	0,1 max.
Magnesium %	0,6 – 1,2	1,0 – 1,4	0,35 – 0,6
Chromium %	0,25 max.	0,1 max.	0,05 max.
Zinc %	0,2 max.	0,2 max.	0,15 max.
Titanium %	0,1 max.	0,2 max.	0,1 max.
Others %	each element 0,05 max., total 0,15 max.		
Aluminium	Remainder	Remainder	Remainder

NOTE Materials AlMgSi1 and AlMgSi0,5 are equivalent to alloys EN AW-6082 and EN AW-6060 respectively in EN 573-3.

The pressure bearing parts of the cylinder shall be AlMgSi1 or AlMg1Si1. For non pressure bearing parts AlMgSi0,5 may be used.

The manufacturer shall specify the guaranteed minimum values for the yield stress, tensile strength and elongation in the finished cylinders. In all cases, the elongation after fracture shall not be less than 12 %.

4.2 Unalloyed aluminium, containing at least 99,5 % aluminium, or aluminium alloys other than those specified in Table 1 may also be used provided that:

EN 13110:2002 (E)

- a) all requirements of this European Standard are met;
- b) LPG/material compatibility is checked according to EN ISO 11114-1;
- c) the requirements for corrosion resistance according to annex B are satisfied;

NOTE A more detailed description of the techniques for carrying out the corrosion tests can be found in EN 12862.

- d) the manufacturer demonstrates that the material used is suitable for the manufacture of cylinders, the expected service life and the likely conditions of use.

4.3 The welding materials selected by the manufacturer shall be compatible with the base materials and shall produce welds which meet the minimum strength values used in the design of the cylinder and guaranteed by the manufacturer in the finished cylinders.

4.4 The manufacturer shall keep certificates according to EN 10204 type 3.1 B covering ladle analysis and chemical properties for material used for pressure retaining parts of the cylinder.

4.5 The manufacturer shall maintain a system of identification for materials used in the manufacture so that all materials used in the manufacture of the cylinder can be traced to their origin.

5 Design**5.1 General requirements**

5.1.1 Calculation of the wall thickness of the pressure bearing parts shall be related to the minimum guaranteed yield stress (R_e) in the finished cylinder.

5.1.2 For calculation purposes the value of R_e shall be limited to a maximum of 0,85 R_g .

5.1.3 The calculation of wall thickness shall be based on the test pressure P_h of 30 bar.

5.1.4 A fully dimensioned drawing, including material specifications, shall be produced.

5.2 Calculation of cylindrical wall thickness

The wall thickness of the cylindrical shell, including any cylindrical part of the ends, shall not be less than:

$$a = \frac{P_h D}{\left(20R_e v / 1,3\right) + P_h}$$

where

For parts of the cylinder without longitudinal seam: $v = 1,0$

For parts of the cylinder with longitudinal seam: $v = 0,9$

In no case shall the actual thickness be less than that specified in 5.5.

5.3 Design of ends concave to pressure

5.3.1 Except as permitted in 5.4 the shape of ends of cylinders shall meet the following limitations:

— for torispherical ends: $R \leq D$; $r \geq 0,1 D$; $h \geq 4 b$ (see Figure 1)

$$H = (R + b) - \sqrt{\left[(R + b) - \frac{D}{2} \right] \left[(R + b) + \frac{D}{2} - 2(r + b) \right]}$$

— for semi-ellipsoidal ends $H \geq 0,192 D$; $h \geq 4b$ (see Figure 1)

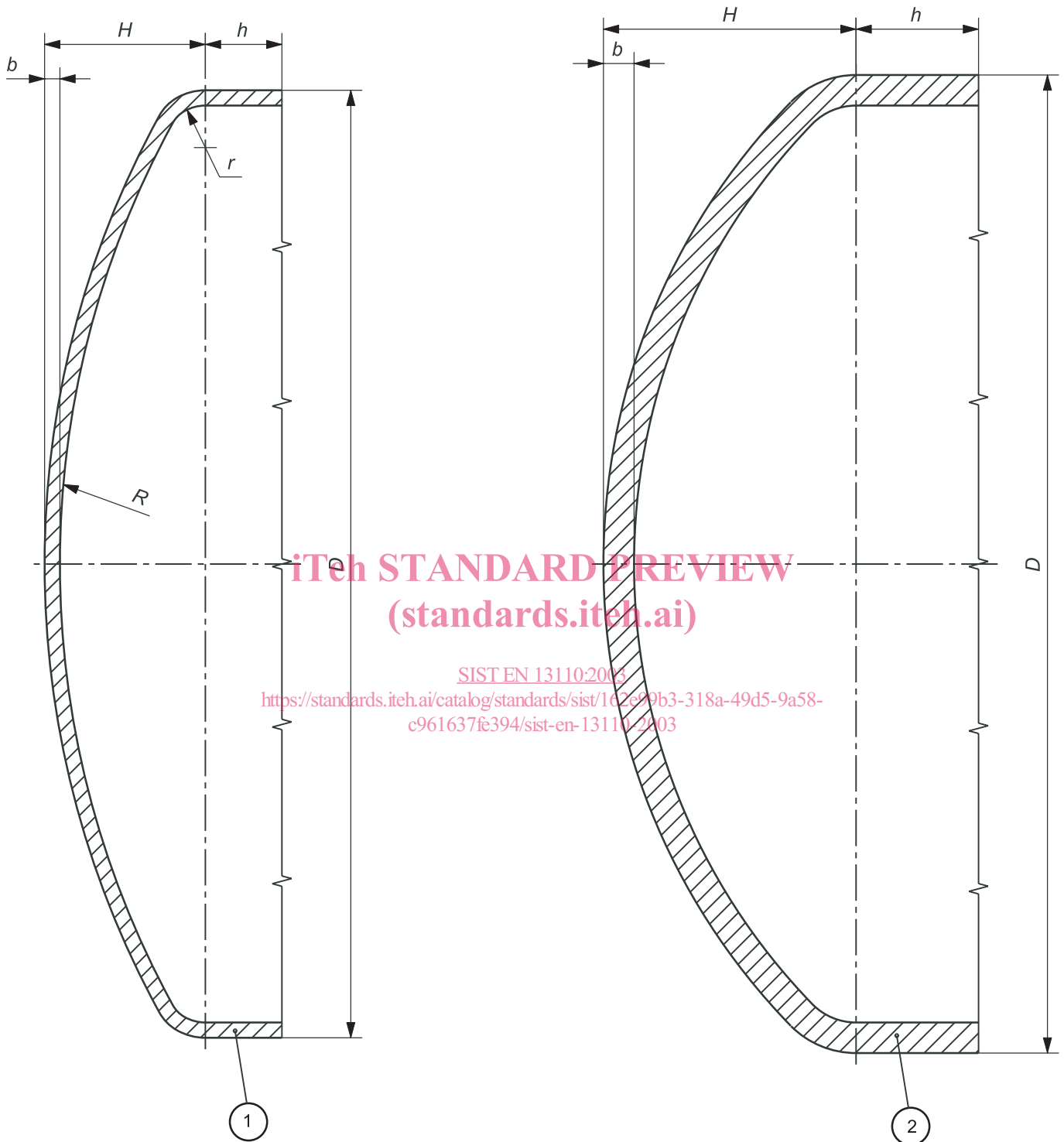
5.3.2 The wall thickness of the ends of cylinders shall not be less than:

$$b = \frac{P_h D C}{\left(\frac{20R_e}{1,3} \right) + P_h}$$

The value of C shall be obtained from Table 2 or the graphs given in Figure 2 and Figure 3.

Table 2 — Relationship between H/D and shape factor C

H/D	C	H/D	C
0,25	1,000	0,38	0,612
0,26	0,931	0,39	0,604
0,27	0,885	0,40	0,596
0,28	0,845	0,41	0,588
0,29	0,809	0,42	0,581
0,30	0,775	0,43	0,576
0,31	0,743	0,44	0,572
0,32	0,713	0,45	0,570
0,33	0,687	0,46	0,568
0,34	0,667	0,47	0,566
0,35	0,649	0,48	0,565
0,36	0,633	0,49	0,564
0,37	0,621	0,50	0,564
NOTE	Intermediate values can be obtained by linear interpolation.		

**Key**

- 1 Torispherical end
- 2 Semi-ellipsoidal end

Figure 1 — Illustration of cylinder ends concave to pressure