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**prEN 13110**

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English Version

## LPG equipment and accessories - Transportable refillable welded aluminium cylinders for liquefied petroleum gas - Design and construction

Equipements pour gaz de pétrole liquéfiés et leurs  
accessoires — Bouteilles soudées transportables et  
rechargeables en aluminium pour gaz de pétrole liquéfié  
(GPL) — Conception et construction

Ortsveränderliche, wiederbefüllbare geschweißte Flaschen  
aus Aluminium für Flüssiggas (LPG) - Gestaltung und  
Konstruktion

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 286.

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## Foreword

This document (prEN 13110:2009) has been prepared by Technical Committee CEN/TC 286 “Liquefied petroleum gas equipment and accessories”, the secretariat of which is held by NSAI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13110:2002.

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 EC Directive.

For relationship with EC Directive, see informative Annex B, which is an integral part of this document.

The main technical changes are the additional of environmental considerations, reference to the latest welding standards, the introduction of radioscopy as a permitted alternative to radiographic examination of welds, and simplification of the marking requirements by reference to EN 14894.

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

Annex A is normative. iTeh STANDARD PREVIEW

The main modifications concern the following : (standards.iteh.ai)

- The addition of an Environmental Annex (informative)
  - Removal of the marking requirements
- SIST EN 13110:2012  
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## Introduction

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

Protection of the environment is a key political issue in Europe and elsewhere. Protection of the environment is taken in a very broad sense. What is meant is the total life cycle aspects of, e.g. a product on the environment, including expenditure of energy and during all phases from mining of raw materials, fabrication, packaging, distribution, use, scrapping, recycling of materials, etc.

It is recommended that manufacturers develop an environmental management policy. For guidance see ISO 14000 series

Provisions have to be restricted to a general guidance. Limit values are specified in national laws.

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.

All pressures are gauge unless otherwise stated.

NOTE: This standard requires measurement of material properties, dimensions and pressures. All such measurements are subject to a degree of uncertainty due to tolerances in measuring equipment etc. It may be beneficial to refer to the leaflet "measurement uncertainty leaflet (SP INFO 2000 27 uncertainty pdf)",

## 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).

EN 462-1, *Non-destructive testing – Image quality of radiographs – Part 1: Image quality indicators (wire type) – Determination of image quality value*

EN 462-2, *Non-destructive testing – Image quality of radiographs – Part 2: Image quality indicators (step/hole type) – Determination of image quality value*

EN 473:2000, *Non-destructive testing – Qualification and certification of NDT personnel – General principles*

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 1435:1997, *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 10204:2004, *Metallic materials – Types of inspection documents.*
- EN 14717, *Welding and allied processes – Environmental check list*
- EN 14784-1, *Non-destructive testing – Industrial computed radiography with storage phosphor imaging plates – Classification of systems*
- EN 14784-2, *Non-destructive testing – Industrial computed radiography with storage phosphor imaging plates – General principles for testing of metallic materials using X-rays and gamma rays*
- EN 14894, *LPG equipment and accessories. Cylinder and drum marking*
- EN ISO 9606-2, *Qualification testing of welders – Fusion welding – Part 2: Aluminium and its alloys.*
- EN ISO 10042: 2005, *Welding - Arc-welded joints in aluminium and its alloys – Quality levels for imperfections (ISO 10042:2005).*
- 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).*
- EN ISO 15607, *Specification and qualification of welding procedures for metallic materials – General rules*
- EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding.*
- EN ISO 15614-2, *Specification and qualification of welding procedures for metallic materials – Part 2: Arc welding of aluminium and its alloys.*

### 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 strength**

0,2 % proof strength  $R_{p0,2}$  (non-proportional elongation) for aluminium alloys, and the 1 % proof strength 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 7.3, 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 and Figure 7).
- 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 strength, guaranteed by the manufacturer for the finished cylinder, in  $\text{N/mm}^2$ .
- $R_g$  Minimum value of tensile strength, guaranteed by the manufacturer for the finished cylinder, in  $\text{N/mm}^2$ .
- $R_m$  Actual value of tensile strength, determined by the tensile test specified in 7.3, in  $\text{N/mm}^2$ .

$R_{p0,2}$  Actual value of yield strength, determined by the tensile test specified in 7.3, in N/mm<sup>2</sup>.

$\nu$  Utilisation factor for the permissible calculation tension (stress reduction factor).

## 4 Materials

4.1 The manufacturer shall endeavour to acquire materials and components from suppliers who have a declared environmental policy, see ISO 14021, ISO 14024 and ISO 14025.

4.2 Except as permitted in 0, the alloys used shall be in accordance with Table 1:

**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 strength, tensile strength and elongation in the finished cylinders. In all cases, the elongation after fracture shall not be less than 12 %.

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

All requirements of this European Standard are met;

LPG/material compatibility is checked according to EN ISO 11114-1;

The requirements for corrosion resistance according to Annex A are satisfied;

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

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

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**4.4** 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.

**4.5** The manufacturer shall keep certificates according to EN 10204:2004 type 3.1 or higher covering ladle analysis and chemical properties for material used for pressure retaining parts of the cylinder.

**4.6** 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 strength ( $R_e$ ) 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.

**5.1.5** The design of the cylinder shall take the following into account;

- Minimising the use of materials
- The fittings required for the cylinder
- Minimising the environmental impact of in service maintenance and end of life disposal.
- Efficient transport of finished product

**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**

<b><math>H/D</math></b>	<b>C</b>	<b><math>H/D</math></b>	<b>C</b>
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.

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