SLOVENSKI STANDARD
oSIST prEN 1442:2014

01-november-2014

Oprema in pribor za utekočinjeni naftni plin (UNP) - Ponovno polnljive varjene plinske jeklenke za UNP - Konstruiranje in izdelava

LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Design and construction

Flüssiggas-Geräte und Ausrüstungsteile - Ortsbewegliche, wiederbefüllbare, geschweißte Flaschen aus Stahl für Flüssiggas (LPG) - Auslegung und Bau

Équipements pour GPL et leurs accessoires - Bouteilles en acier soudé transportables et rechargeables pour gaz de pétrole liquéfiés (GPL) - Conception et fabrication

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Ta slovenski standard je istoveten z: **prEN 1442 rev**

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders

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2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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August 2014

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Will supersede EN 1442:2006+A1:2008

English Version

LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Design and construction

Équipements pour GPL et leurs accessoires - Bouteilles en acier soudé transportables et rechargeables pour gaz de pétrole liquéfiés (GPL) - Conception et fabrication

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

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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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN 1442:2014) has been prepared by Technical Committee CEN/TC 286 “LPG 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 1442:2006+A1:2008.

This European Standard has been submitted for reference into the RID [5] and/or in the technical annexes of the ADR. Therefore 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 standards themselves are referred to in the RID and/or in the technical annexes of the ADR [6].

This European Standard has been extensively re-formatted to align with other more recent LPG cylinder standards.

The main technical changes are;

— the inclusion of over-moulded cylinders;

— re-establishing 50 bar as the minimum burst pressure.

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Introduction

This European Standard calls for the use of substances and procedures that may 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.

All pressures are gauge pressures unless otherwise stated.

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1 Scope

This European Standard specifies the minimum requirements for the design, construction and testing during manufacture of transportable refillable welded steel Liquefied Petroleum Gas (LPG) cylinders, of water capacity from 0,5 l up to and including 150 l, exposed to ambient temperatures.

This European Standard applies only to cylinders having a circular cross-section.

2 Normative references

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

EN 10020, *Definition and classification of grades of steel*

EN 10120, *Steel sheet and strip for welded gas cylinders*

EN 10204:2004, *Metallic products — 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 — Part 1: Classification of systems*

EN 14784–2, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 2: 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 14245, *Gas cylinders — Specifications and testing of LPG cylinder valves — Self-closing (ISO 14245)*

EN ISO 15995, *Gas cylinders — Specifications and testing of LPG cylinder valves — Manually operated (ISO 15995)*

EN ISO 643, *Steels — Micrographic determination of the apparent grain size (ISO 643)*

EN ISO 2409:2013, *Paints and varnishes — Cross-cut test (ISO 2409)*

EN ISO 2812-2, *Paints and varnishes — Determination of resistance to liquids – Part 2:Water immersion method (ISO 2812-2)*

EN ISO 3231:1997, *Paints and varnishes — Determination of resistance to humid atmospheres containing sulfur dioxide (ISO 3231)*

EN ISO 4136:2012, *Destructive tests on welds in metallic materials - Transverse tensile test (ISO 4136)*

EN ISO 4624, *Paints and varnishes — Pull-off test for adhesion (ISO 4624)*

EN ISO 5173:2010, *Destructive tests on welds in metallic materials - Bend tests (ISO 5173)*

EN ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817)*

EN ISO 6520–1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding (ISO 6520-1)*

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EN ISO 6892-1:2009, *Metallic materials - Tensile testing – Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227)*

EN ISO 9606-1, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1)*

EN ISO 9712, Non-destructive testing - Qualification and certification of NDT personnel(ISO 9712)

EN ISO 11117:2008, *Gas cylinders. Valve protection caps and valve guards - Design, construction and tests (ISO 11117)*

EN ISO 11997-2, *Paints and varnishes — Determination of resistance to cyclic corrosion conditions — Part 2: Wet (salt fog)/dry/humidity/UV light (ISO 11997-2)*

EN ISO 14732, *Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613)*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1)*

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EN ISO 17636-2:2013, *Non-destructive testing of welds - Radiographic testing – Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2)*

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EN ISO 17637:2011, *Non-destructive testing of welds - Visual testing of fusion-welded joints (ISO 17637)*

EN ISO 17639, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds (ISO 17639)*

EN ISO 19232-1, *Non-destructive testing - Image quality of radiographs – Part1: Determination of the image quality value using wire-type image quality indicators (ISO 19232-1)*

EN ISO 19232-2, *Non-destructive testing - Image quality of radiographs – Part 2: Determination of the image quality value using step/hole-type image quality indicators (ISO 19232-2)*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
yield strength
upper yield strength ReH or, for steels that do not exhibit a definite yield, the 0,2 % proof strength Rp0,2

3.1.2
normalised
condition resulting from heat treatment to a uniform temperature above the upper critical point (Ac3) of the steel and then cooled under controlled conditions

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3.1.3
stress relieved
condition resulting from heat treatment in which a finished cylinder is heated to a uniform temperature below the lower critical point (Ac1) of the steel and cooled in a still atmosphere, the object of which is to reduce the residual stresses without altering the metallurgical structure of the steel

3.1.4
weld-overrun zone
area on a circumferential weld where the weld metal deposition has carried on beyond the start point

3.1.5
liquefied petroleum gas
LPG
low pressure liquefied gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

3.1.6
production batch
group of pressure parts or finished pressure vessels, made consecutively by the same manufacturer using the same manufacturing techniques to the same design, nominal size and material specifications on the same production machinery and subject to the same heat treatment conditions

Note 1 to entry: In this context, 'consecutively' need not imply continuous production.

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3.1.7
protective coating
layer of clear or pigmented material applied to the cylinder as protection

3.1.8
over-moulded cylinder
a coated steel or stainless steel cylinder with a non-removable over-moulded protective case in polyurethane or material which provides equivalent protection.

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Note 1 to entry: also see ADR definition

3.2 Symbols

A percentage elongation after fracture.

a calculated thickness of the cylindrical shell, in millimetres.

b calculated thickness of the end of the cylinder, in millimetres.

C shape factor for ends (see Table 2, Figure 2 and Figure 3).

D outside diameter of the cylinder as given in the design drawing (see Figure 1), in millimetres.

D_p outside diameter of a bend test mandrel (see Figure 8), in millimetres.

e actual thickness of the material in the finished cylinder (at the point under consideration), in millimetres.

h height of the cylindrical part of the end (see Figure 1), in millimetres.

H outside height of the domed part of the end (see Figure 1), in millimetres.

J stress reduction factor.

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L_o original gauge length of the test piece, in accordance with EN ISO 4136:2012, and EN ISO 6892-1:2009 in millimetres.

n ratio of diameter of bend test former to the thickness of the test piece, (see Table 6).

P_c calculation pressure (1 bar = 10^5 Pa = 10^5 N/m^2), used to calculate the minimum required thickness of the cylindrical shell and ends, in bar.

P_b maximum pressure attained during the burst test, in bar.

P_h actual test pressure applied to the cylinder by the manufacturer, in bar.

P_{hmin} minimum permissible test pressure, in bar.

r inside knuckle radius of the torispherical end, in millimetres.

R inside spherical radius of the torispherical end, in millimetres.

R_g minimum value of tensile strength guaranteed by the cylinder manufacturer for the finished cylinder, in Newton's per square millimetre.

R_o minimum value of yield strength guaranteed by the cylinder manufacturer for the finished cylinder, in Newton's per square millimetre.

R_m actual value of tensile strength determined by the tensile test specified in 7.4, in Newton's per square millimetre.

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R_{eH} upper yield strength, in Newton's per square millimetre, as defined in EN ISO 4136:2012.

$R_{p0,2}$ Proof strength, non-proportional extension in Newton's per square millimetre, as defined in EN ISO 4136:2012.

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4 Materials

4.1 Materials for shells and end forming shall be in accordance with EN 10020 or other equivalent material specification or standard meeting the requirements of Table 1. Alternative material specifications shall, as a minimum, specify chemical composition, mechanical properties, heat treatment and delivery conditions.

Note: "Materials" refers to materials in the state before any specific transformation occurring during the manufacturing process.

4.2 Steels for the pressure receptacle shall not be affected or weakened by the intended contents (LPG) and shall not cause a dangerous effect e.g. catalysing a reaction or reacting with the dangerous goods. The steel shall be resistant to brittle fracture and to stress corrosion cracking.

4.3 All parts welded to the cylinder shall be made of material compatible with the cylinder material.

4.4 The welding consumables shall be such that they are capable of giving consistent welds.

4.5 The cylinder manufacturer shall obtain certificates showing the chemical analysis and details of the mechanical properties of the steel supplied for the construction of the pressure retaining parts. The certificates/reports shall be in accordance with EN 10204:2004, Type 3.1 for shells and ends and Type 2.2 for the valve boss.

4.6 The manufacturer shall maintain a system of identification for the materials used in the fabrication in order that all materials for pressure parts in the completed cylinder can be traced to their origin.

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The manufacturer shall endeavour to acquire materials and components from suppliers who have a declared environmental policy, see EN ISO 14021 [7], EN ISO 14024[8] and EN ISO 14025[9].

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Table 1 — Material Requirements

Element	Limits %
Materials, other than those according to EN 10020, *Definition and classification of grades of steel* EN 10120, used for the fabrication of cylinders shall be of weldable quality and the following limits shall not be exceeded in the cast analysis:	
Carbon	0,22 max.
Silicon	0,50 max.
Manganese	0,30 min. to 1,60 max.
Phosphorus	0,025 max.
Sulphur	0,020 max.
Phosphorous plus sulphur	0,040 max.
Use of micro-alloying elements such as niobium, titanium and vanadium shall be limited to the following contents:	
Niobium	0,05 max.
Titanium	0,05 max.
Vanadium	0,05 max.
Niobium plus vanadium	0,08 max.
Where other micro-alloying elements are used, their presence and amounts shall be reported, together with the above, in the steel manufacturer's certificate. Should check analyses be required, they shall be carried out either on specimens taken during manufacture from material in the form as supplied by the steel manufacturer to the cylinder manufacturer or from finished cylinders.	

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5 Design

5.1 General requirements

5.1.1 The calculation of the wall thickness of the pressure parts shall be based on the yield strength of the material.

5.1.2 For calculation purposes, the value of the yield strength R_o is limited to a maximum of 0,85 R_g.

5.1.3 The calculation pressure (P_c) shall be not less than the higher of:

— absolute developed pressure at 65 °C of the highest pressure LPG mixture to be filled minus 1 bar; or

— 10 bar.

Note 1: This requirement is in accordance with RID/ADR.

Note 2: See RID/ADR 4.1.4.1 P200 Table 2 for LPG test pressures.

5.1.4 A drawing, which includes full dimensions that define the cylinder type (see 8.3) and the specification of the material, shall be produced.

5.1.5 The design of the cylinder should take into account the following:

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— ease of manual handling;

— ease of connection for filling;

— ease of connection for the end user;

— safe stacking (when designed to be stacked);

— minimising the use of materials; and

— minimising the environmental impact of in service maintenance and end of life disposal.

5.2 Calculation of cylindrical shell thickness

The wall thickness, *a*, of the cylindrical shell shall be not less than:

$$a = \frac{P_c \times D}{(15 \times R_o \times J) + P_c}$$

For cylindrical shells with a longitudinal weld: $J = 0,9$

For cylindrical shells, including the cylindrical parts of ends, without a longitudinal weld: $J = 1,0$

5.3 Design of torispherical and semi-ellipsoidal ends concave to pressure

5.3.1 The shape of the ends shall be such that the following conditions are fulfilled:

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

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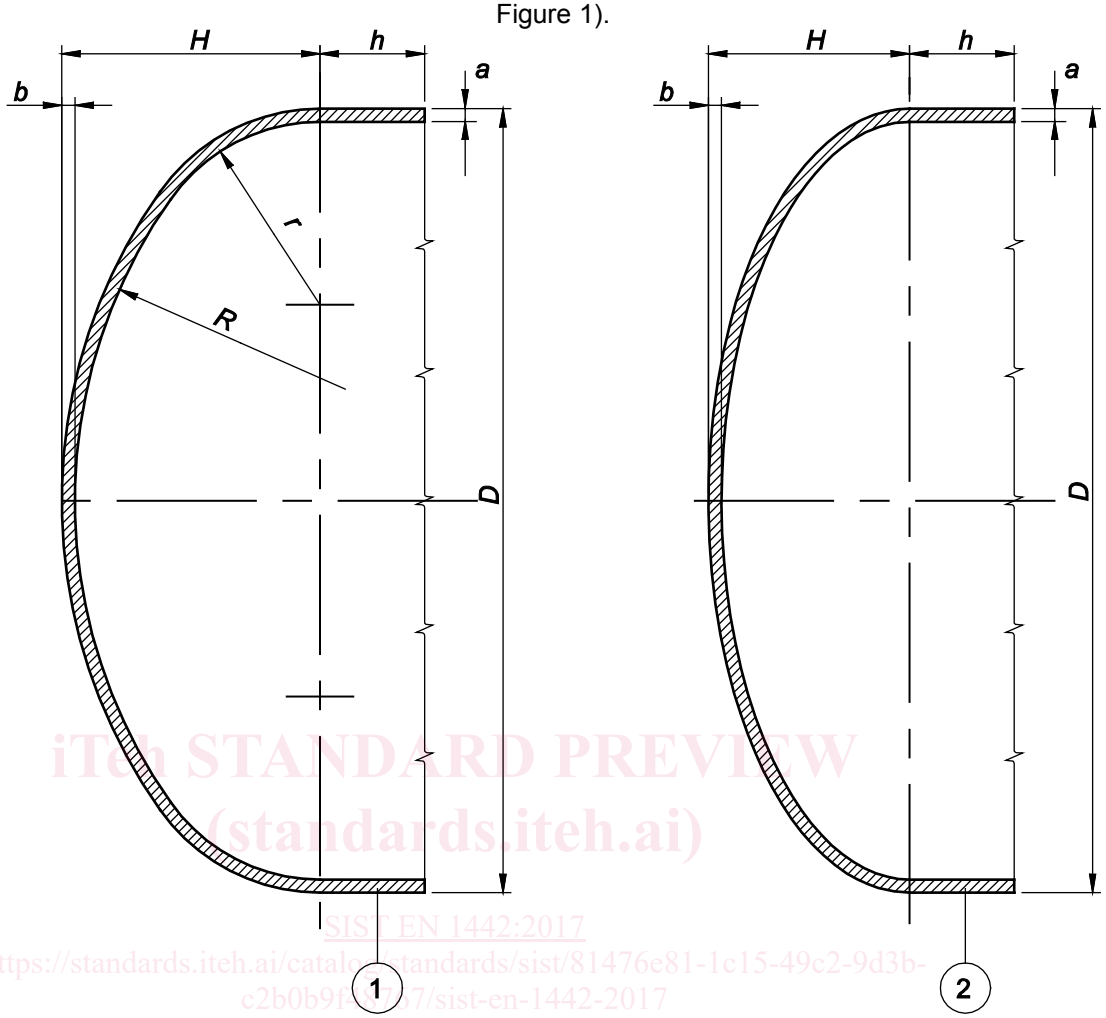
— for semi-ellipsoidal ends $H \geq 0{,}2\ D$; $h \geq 4b$ (see Figure 1).



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Key

1 torispherical end
2 semi-ellipsoidal end

Figure 1 — Illustration of cylinder ends concave to pressure

NOTE For torispherical ends the height H can be calculated using:

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

5.3.2 The wall thickness, a, of any cylindrical part shall be calculated in accordance with 5.2.

This requirement is not applicable where the length of the cylindrical portion of the cylinder, measured between the beginning of the domed parts of the two ends, is not more than $\sqrt{2bD}$. In this case the wall thickness shall not be less than that of the domed part.

The thickness, b, of the domed part shall be not less than:

$$b = \frac{P_c \times D \times C}{(15 \times R_o) + P_c}$$