
Oprema in pribor za utekočinjeni naftni plin (UNP) - Premične, ponovno polnljive jeklenke iz kompozitnih materialov za UNP - Konstruiranje in izdelava

LPG equipment and accessories - Transportable refillable composite cylinders for LPG - Design and construction

Flüssiggas-Geräte und Ausrüstungsteile - Ortsbewegliche wiederbefüllbare vollumwickelte Flaschen aus Verbundwerkstoff für Flüssiggas (LPG) - Gestaltung und Konstruktion

Équipements pour gaz de pétrole liquéfiés et leurs accessoires - Bouteilles entièrement bobinées en matériau composite, transportables et rechargeables pour gaz de pétrole liquéfié (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.

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European foreword

This document (prEN 14427:2020) 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 will be submitted to the enquiry.

This document will supersede EN 14427:2014.

This document has been submitted for reference in

- the RID and
- the technical annexes of the ADR

NOTE: These regulations take precedence over any clause of this standard. It is emphasized that RID/ADR are being revised regularly at intervals of two years which may lead to temporary non-compliances with the clauses of this document.

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prEN 14427:2020 (E)**Introduction**

This document calls for the use of substances and procedures that can 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 document that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Protection of the environment is a key political issue in Europe and elsewhere, for CEN/TC 286 this is covered in CEN/TS 16765 [17] and this Technical Specification should be read in conjunction with this standard. This Technical Specification provides guidance on the environmental aspects to be considered regarding equipment and accessories produced for the LPG industry and the following is addressed:

- a) design;
- b) manufacture;
- c) packaging;
- d) use and operation; and
- e) disposal.

All pressures are gauge unless otherwise stated.

NOTE This document 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" [14].

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1 Scope

This document

- specifies minimum requirements for materials, design, construction, prototype testing and routine manufacturing inspections of fully wrapped composite cylinders with a water capacity from 0,5 litre up to and including 150 litres for liquefied petroleum gases (LPG) exposed to ambient temperatures, with a test pressure of at least 30 bar;
- is only applicable to cylinders which are fitted with a pressure relief valve (see 4.1.3);
- is applicable to cylinders with a liner of metallic material (welded or seamless) or non-metallic material (or a mixture thereof), reinforced by fibres of glass, carbon or aramid (or a mixture thereof);
- is also applicable to composite cylinders without liners.

Cylinders manufactured to this document are suitable for temperatures down to $-40\text{ }^{\circ}\text{C}$.

This document does not address the design, fitting and performance of removable protective sleeves. Where these are fitted, the choice of material and sleeve performance should be considered separately.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1442, *LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Design and construction*

EN 1964-3, *Transportable gas cylinders - Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0,5 litre up to and including 150 litres - Part 3: Cylinders made of seamless stainless steel with an R_m value of less than 1100 MPa*

EN 12165, *Copper and copper alloys - Wrought and unwrought forging stock*

EN 12807, *LPG equipment and accessories - Transportable refillable brazed steel cylinders for liquefied petroleum gas (LPG) - Design and construction*

EN 13110, *LPG equipment and accessories - Transportable refillable welded aluminium cylinders for liquefied petroleum gas (LPG) - Design and construction*

EN 14140, *LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Alternative design and construction*

EN 14717, *Welding and allied processes - Environmental check list*

EN 14894, *LPG equipment and accessories - Cylinder and drum marking*

EN ISO 75-1, *Plastics - Determination of temperature of deflection under load - Part 1: General test method (ISO 75-1)*

EN ISO 75-3, *Plastics - Determination of temperature of deflection under load - Part 3: High-strength thermosetting laminates (ISO 75-3)*

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EN ISO 175, *Plastics - Methods of test for the determination of the effects of immersion in liquid chemicals (ISO 175)*

EN ISO 527-1, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1)*

EN ISO 527-2, *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 1133 (all parts), *Plastics - Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics (ISO 1133)*

EN ISO 1183-1, *Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1)*

EN ISO 1183-2, *Plastics - Methods for determining the density of non-cellular plastics - Part 2: Density gradient column method (ISO 1183-2)*

EN ISO 1183-3, *Plastics - Methods for determining the density of non-cellular plastics - Part 3: Gas pycnometer method (ISO 1183-3)*

EN ISO 2555, *Plastics - Resins in the liquid state or as emulsions or dispersions - Determination of apparent viscosity using a single cylinder type rotational viscometer method (ISO 2555)*

EN ISO 2884-1, *Paints and varnishes - Determination of viscosity using rotary viscometers - Part 1: Cone-and-plate viscometer operated at a high rate of shear (ISO 2884-1)*

EN ISO 3146, *Plastics - Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (ISO 3146)*

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

EN ISO 7866, *Gas cylinders - Refillable seamless aluminium alloy gas cylinders - Design, construction and testing (ISO 7866)*

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

EN ISO 9809-1, *Gas cylinders - Design, construction and testing of refillable seamless steel gas cylinders and tubes - Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa (ISO 9809-1)*

EN ISO 9809-2, *Gas cylinders - Design, construction and testing of refillable seamless steel gas cylinders and tubes - Part 2: Quenched and tempered steel cylinders and tubes with tensile strength greater than or equal to 1 100 MPa (ISO 9809-2)*

EN ISO 9809-3, *Gas cylinders - Design, construction and testing of refillable seamless steel gas cylinders and tubes - Part 3: Normalized steel cylinders and tubes (ISO 9809-3)*

EN ISO 11114-2, *Gas cylinders - Compatibility of cylinder and valve materials with gas contents - Part 2: Non-metallic materials (ISO 11114-2)*

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 15512, *Plastics - Determination of water content (ISO 15512)*

EN ISO 16474-3:2013, *Paints and varnishes - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps (ISO 16474-3)*

ISO 1637, *Wrought copper and copper alloy rod and bar — Technical conditions of delivery*

ISO 3341, *Textile glass — Yarns — Determination of breaking force and breaking elongation*

ISO 4587, *Adhesives — Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies*

ISO 8521, *Glass-reinforced thermosetting plastic (GRP) pipes — Test methods for the determination of the initial circumferential tensile wall strength*

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization*

ASTM D 2196, *Test methods for rheological properties of non-newtonian materials by rotational (Brookfield type) viscometer*

ASTM D 2290, *Test method for apparent hoop tensile strength of plastics and reinforced plastic by split disk method*

ASTM D 2291 *Standard practice for fabrication of ring test specimens for glass-resin composites*

ASTM D 2343, *Standard test method for tensile properties of glass fibre strands, yarns and rovings used in reinforced plastics*

ASTM D 2344, *Standard test method for short-beam strength of polymer matrix composite materials and their laminates*

ASTM D 3418, *Standard test method for transition temperatures and enthalpies of fusion and crystallization of polymers by differential scanning calorimetry*

ASTM D 4018 *Standard test methods for tensile properties of continuous filament carbon and graphite fibre tows*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

3.1

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

prEN 14427:2020 (E)**3.2****ambient test temperature**

temperature of surroundings varying between 10 °C and 35 °C (for test purposes only)

3.3**autofrettage**

pressure application procedure which strains the metal liner past its yield point sufficiently to cause permanent plastic deformation, and results in the liner having compressive stresses and the fibres having tensile stresses when at zero internal gauge pressure

3.4**batch**

<fibres> of fibres, pre-impregnated fibres or components of the matrix system homogeneous quantity of material, identified and certified as such by the supplier

3.5**batch**

<metallic liners> quantity of liners of the same nominal diameter, thickness, length and design, made successively from the same material cast and subjected to the same heat treatment for the same length of time

3.6**batch**

<non-metallic liners> quantity of liners of the same nominal diameter, thickness, length and design, made successively from the same batch of materials and subjected to the same manufacturing process

3.7**batch**

<finished cylinders with liners> quantity of up to 200 finished cylinders, plus cylinders for destructive testing, of the same nominal diameter, thickness, length and design

Note 1 to entry: The batch may contain different batches of liners, providing the batches are nominally the same and have had the same treatment, fibres and matrix materials.

3.8**batch**

<finished cylinders with no liners> quantity of up to 200 finished cylinders, plus cylinders for destructive testing, of the same nominal diameter, thickness, length and design

3.9**burst pressure**

highest pressure reached in a cylinder or liner during the relevant burst test

3.10**composite overwrap**

fibres, or fibres embedded in a matrix taken together as a combined unit

3.11**elastomeric material**

material which at ambient temperature can be stretched repeatedly to at least twice its original length and will return with force to approximately its original length immediately upon release of the stress

3.12**exterior coating**

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

3.13**fibre
strand**

load-carrying part of the composite overwrap e.g. glass, aramid or carbon

3.14**fully wrapped composite cylinder**

cylinder reinforced by wrapping to take both circumferential and longitudinal stress

Note 1 to entry: these are referred within this document as types 3, 4 and 5 (refer to 3.23, 3.24 and 3.25)

3.15**liner**

metallic or non-metallic vessel that retains the LPG in the cylinder, but may also contribute to the mechanical behaviour of the cylinder

Note 1 to entry: This is a load sharing liner

3.16**neck ring**

collar or ring with or without external threads, securely attached to the cylinder neck by means other than welding, brazing or soldering

3.17**non-load sharing liner**

liner with burst pressure of less than 5% of the nominal burst pressure of the finished composite cylinder and is intended only to prevent diffusion of LPG

3.18**non-metallic liner**

liner made from thermoplastic, thermosetting, or elastomer material

3.19**matrix**

material which is used to bind and hold the fibres in place

3.20**thermoplastic**

plastics capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature

3.21**thermoset**

plastics which when cured by the application of heat or chemical means changes into a substantially infusible and insoluble product

prEN 14427:2020 (E)**3.22****removable protective sleeve**

external sleeve intended to provide protection to the cylinder during operation which is not an integral part of the design, not permanently fixed to the cylinder but which can be removed during service without destroying the sleeve without the use of special tools

3.23**type 3 cylinder**

fully wrapped cylinder with a load-sharing metal liner and composite reinforcement on both cylindrical and dome ends

3.24**type 4 cylinder**

fully wrapped cylinder with a non-load sharing liner and composite reinforcement on both cylindrical and dome ends

3.25**type 5 cylinder**

fully wrapped cylinder without a liner and with composite reinforcement on both the cylindrical portion and the dome ends

3.26**major Interruption**

where a process is halted for more than 6 hours, due to an unscheduled event

EXAMPLE break down of production equipment needing replacement.

4 Design and manufacture

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4.1 General

4.1.1 Fully wrapped composite LPG cylinders may be manufactured with a metallic or non-metallic liner or without a liner.

The thicknesses of the cylinder, including any liner, shall be determined by satisfactory completion of the performance tests described in Clause 5. No design calculations are required.

The cylinder may also include an external coating and/or additional parts such as valve shrouds/handles, bases and cages. Where these are an integral part of the design, they shall be permanently fixed to the cylinder such that they cannot be removed during service without destroying them, or by use of special tools.

The design of the cylinder shall take the following into account:

- minimizing the use of materials;
- the fittings required for the cylinder;
- minimizing the environmental impact of in service maintenance and end of life disposal;
- efficient transport of finished product.

For the welding associated with metallic liners, the environmental impact of welding and allied processes shall be assessed in accordance with EN 14717.

The manufacturer should endeavour to minimize wastage of material by selecting appropriately sized materials related to the finished parts required for manufacture. Unavoidable waste/scrap material should be recycled where possible.

Noise levels and harmful emissions from the production process should be evaluated and measures put into place to minimize the impact upon the external environment.

4.1.2 The location of all openings for service connections shall be restricted to one end of the cylinder.

Where it is necessary, for production reasons, to have an opening in both ends, the non-service opening shall be permanently sealed before completion of the cylinder. The sealing arrangement shall be:

- permanent;
- inaccessible to users of the cylinder in service; and
- designed so that any leakage of product past the seal can only be released local to the service valve(s) so that it will be detectable during post-fill leak checks.

4.1.3 Due to their limited volumetric expansion, cylinders designed to this document are intended to be used only when fitted with a pressure relief valve (see EN 13953).

4.2 Liner

4.2.1 Metallic liners

4.2.1.1 Metallic liners shall be manufactured in accordance with the relevant clauses of the following European Standards:

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- a) seamless steel liners: EN ISO 9809-1, EN ISO 9809-2 or EN ISO 9809-3, as appropriate;
- b) seamless stainless steel liners: EN 1964-3;
- c) seamless aluminium alloy liners: EN ISO 7866;
- d) welded steel liners: EN 1442 or EN 14140;
- e) brazed steel liners: EN 12807;
- f) welded aluminium liners: EN 13110.
- g) Brass boss inserts EN 12165, ISO 1637 or equivalent (composition).

4.2.1.2 The relevant clauses are those covering: materials, thermal treatments, neck design, construction and workmanship, mechanical tests.

NOTE This excludes the design requirements, since the design is determined by the manufacturer in accordance with this document for the design of the composite cylinder.

4.2.2 Non-metallic liners

4.2.2.1 A non-metallic liner shall be designed as non-load sharing. The liner material shall be compatible with LPG. Guidance to material compatibility is given in EN ISO 11114-2.

4.2.2.2 Where a metal end boss or end boss insert is used in a non-metallic liner, it shall be considered part of the liner material and shall fulfil the material requirements specified in the relevant standard listed in 4.2.1.1.