SLOVENSKI STANDARD
SIST EN 14427:2014

01-september-2014

Nadomešča:
SIST EN 14427:2004
SIST EN 14427:2004/A1:2006

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

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

Flüssiggas-Geräte und Ausrüstungsteile - Ortsbewegliche wiederbefüllbare vollumwickelte Flaschen aus Verbundwerkstoff für Flüssiggas (LPG) - Auslegung und Bau

Équipements pour gaz de pétrole liquéfiés et leurs accessoires - Bouteilles en matériau composite, transportables et rechargeables, pour gaz de pétrole liquéfiés (GPL) - Conception et fabrication

Ta slovenski standard je istoveten z: **EN 14427:2014**

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders

SIST EN 14427:2014 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14427

June 2014

ICS 23.020.30

Supersedes EN 14427:2004

English Version

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

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This European Standard was approved by CEN on 4 January 2014.

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 CEN-CENELEC 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 CEN-CENELEC Management Centre has the same status as the official versions.

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

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Foreword

This document (EN 14427:2014) 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 December 2014 and conflicting national standards shall be withdrawn at the latest by December 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14427:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This standard has been submitted for reference into the RID and ADR (see [11] and [12]).

Environmental considerations recorded in Annex C.

The main technical changes to this revision include a full revision of the manufacturing processes in line with advances in manufacturing processes.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard 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 European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

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

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” [14].

1 Scope

This European Standard

— 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 European Standard are suitable for temperatures down to −40 °C.

This European Standard 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, 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 1439, *LPG equipment and accessories - Procedure for checking LPG cylinders before, during and after filling*

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 Rm value of less than 1100 MPa*

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)*

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 pyknometer 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 pyknometer method (ISO 1183-3)*

EN ISO 1628-3, *Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 3: Polyethylenes and polypropylenes (ISO 1628-3)*

EN ISO 2555, *Plastics - Resins in the liquid state or as emulsions or dispersions - Determination of apparent viscosity by the Brookfield Test 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 - Refillable seamless steel gas cylinders - Design, construction and testing - Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa (ISO 9809-1)*

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

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

EN ISO 10286, *Gas cylinders - Terminology (ISO 10286)*

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 16474-3:2013)*

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

ISO 8521, *Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Test methods for the determination of the apparent initial circumferential tensile strength*

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

ASTM D 2196-10, *Test methods for rheological properties of non-newtonian materials by rotational (Brookfield type) viscometer*

ASTM D 2290-08, *Test method for apparent hoop tensile strength of plastics and reinforced plastic by split disk method*

ASTM D 2291-09, *Standard practice for fabrication of ring test specimens for glass-resin composites*

ASTM D 2343-09, *Standard test method for tensile properties of glass fibre strands, yarns and rovings used in reinforced plastics*

ASTM D 2344-00, *Standard test method for short-beam strength of polymer matrix composite materials and their laminates*

ASTM D 3418-08, *Standard test method for transition temperatures and enthalpies of fusion and crystallization of polymers by differential scanning calorimetry*

ASTM D 4018-99, *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 terms and definitions given in EN ISO 10286 and the following apply.

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

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> pre-impregnated fibres or components of the resin 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

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
non-load sharing liner
liner that contributes less than 5 % of the load bearing of the overall cylinder design at test pressure, and is intended only to prevent diffusion of LPG

3.17
non-metallic liner
liner made from thermoplastic, thermosetting, or elastomer material

3.18
matrix
material which is used to bind and hold the fibres in place

3.19
thermoplastic
plastics capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature

3.20
thermoset
plastics which when cured by the application of heat or chemical means changes into a substantially infusible and insoluble product

3.21
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

4 Design and manufacture

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. Cylinder bodies without a liner may be manufactured from two parts joined together with adhesive.

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 the lack of volumetric expansion, cylinders designed to this European Standard 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:

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.

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 European Standard for the design of the composite cylinder.

4.2.2 Non-metallic liners

4.2.2.1 A cylinder with a non-metallic liner shall be designed as if the liner will be non-load sharing. The liner material shall be compatible with LPG as determined by EN ISO 11114-2.

4.2.2.2 Where a metal end boss 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.

4.2.3 Design drawing

4.2.3.1 A fully dimensioned drawing of the liner shall be produced which shall include the specification of the material and material properties.

4.2.3.2 The following properties shall be specified for metallic liners:

— minimum yield stress;

— minimum tensile strength;

— minimum elongation; and

— minimum burst pressure;

4.2.3.3 The following properties shall be specified for non-metallic liners:

— density;

— for thermoplastics, the melting point, as determined by EN ISO 3146 or ISO 11357;

— for thermoset materials, the temperature of deflection under load, as determined by EN ISO 75-1 and EN ISO 75-3;

— for thermoset materials, the glass transition temperature as determined by differential scanning calorimetry;

— composition;

— compatibility with LPG as determined by EN ISO 11114-2; and

— end boss material specification.

NOTE The end boss specifications includes:

— minimum yield stress;

— minimum tensile strength;

— minimum elongation of the boss material.

4.3 Composite overwrap

4.3.1 Materials

Material requirements for the fibre and the matrix, where applicable, shall be as specified by the manufacturer.

4.3.2 Winding

4.3.2.1 Procedures shall be defined for the winding and curing process to ensure good repeatability and traceability.

4.3.2.2 For all cylinders, the following parameters shall be defined and monitored:

a) the batch numbers of the fibres used;

b) the number of strands used;

c) the winding tension per strand, (if applicable);

d) the winding speed(s);

e) the winding angle and/or pitch for each layer; and

f) the number and order of layers.

4.3.2.3 Where a matrix system is used, the following additional parameters shall be defined and monitored:

a) percentages of the components of the matrix system and their batch numbers;

b) resin bath temperature range, (where applicable);

c) the procedure used to obtain correct impregnation (e.g. wet winding or pre-impregnation);

d) the polymerisation cycle; and

e) the polymerisation process (e.g. thermal cycling, ultrasonic, ultraviolet, or radiation).

4.3.2.4 For thermal polymerisation, the temperature and the length of the polymerisation cycle of the resin system shall be such that they do not adversely affect the mechanical characteristics of the liner. In addition, tolerances for holding time and temperature at each stage shall be defined.

4.3.3 Cylinders without liners comprising two parts

For cylinders without liners which comprise two parts joined with adhesive, additional procedures and parameters shall be defined, monitored and recorded for the adhesive system as follows:

a) percentages of the components and their batch numbers;

b) polymerisation cycle; and

c) polymerisation process (e.g. thermal cycling, ultrasonic, ultraviolet, or radiation).

4.4 Finished cylinder

4.4.1 Design drawings

4.4.1.1 A fully dimensioned drawing of all parts that constitute the finished cylinder shall be produced. The design drawing shall also include tolerances on all dimensions, including out-of-roundness and straightness.