SLOVENSKI STANDARD
SIST EN 12493:2021

01-februar-2021

Nadomešča:
SIST EN 12493:2013+A2:2018

Oprema in pribor za utekočinjeni naftni plin (UNP) - Varjene tlačne posode cestnih cistern iz jekla za UNP - Konstruiranje in izdelava

LPG equipment and accessories - Welded steel pressure vessels for LPG road tankers - Design and manufacture

Flüssiggas-Geräte und Ausrüstungsteile - Geschweißte Druckbehälter aus Stahl für Straßentankwagen für Flüssiggas (LPG) - Auslegung und Herstellung

Équipements pour GPL et leurs accessoires - Réservoirs sous pression en acier soudés des camions-citernes pour GPL - Conception et construction

Ta slovenski standard je istoveten z: **EN 12493:2020**

ICS:

23.020.35	Plinske jeklenke	Gas cylinders
43.080.10	Tovornjaki in priklopniki	Trucks and trailers

SIST EN 12493:2021 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12493

December 2020

ICS 23.020.30; 23.020.35

Supersedes EN 12493:2013+A2:2018

English Version

LPG equipment and accessories - Welded steel pressure vessels for LPG road tankers - Design and manufacture

Équipements pour GPL et leurs accessoires - Réservoirs sous pression en acier soudés des camions - Conception et construction

Flüssiggas-Geräte und Ausrüstungsteile - Geschweißte Druckbehälter aus Stahl für Straßentankwagen für Flüssiggas (LPG) - Auslegung und Herstellung

This European Standard was approved by CEN on 16 November 2020.

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.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 12493:2020 E

Contents

Page

European foreword

This document (EN 12493:2020) has been prepared by Technical Committee /TC 286 “LPG 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 June 2021, and conflicting national standards shall be withdrawn at the latest by June 2021.

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

This document supersedes EN 12493:2013+A2:2018.

The following main changes have been introduced during this revision:

— removal of Annex I, Welding imperfections and test specimens;

— addition of normative reference to EN 12972.

This document has been submitted for reference in:

— the RID and/or;

— the technical annexes of the ADR.

NOTE These regulations take precedence over any clause of this document. 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.

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

Introduction

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

Protection of the environment is a key political issue in Europe and elsewhere. For CEN/TC 286 this is covered in CEN/TS 16765 [7] *LPG equipment and accessories — Environmental considerations for CEN/TC 286 standards*; which should be read in conjunction with this document. The 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;

e) disposal.

It is recommended that manufacturers develop an environmental management policy. For guidance, see EN ISO 14000 series (see [8], [9] and [10]).

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

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

All pressures are gauged 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 might be beneficial to refer to the leaflet "measurement uncertainty leaflet" SP INFO 2000 27 [15].

1 Scope

This document specifies minimum requirements for materials, design, construction and workmanship procedures, and tests for welded LPG road tanker pressure vessels and their welded attachments manufactured from carbon, carbon/manganese and micro alloy steels.

There is no upper size limit as this is determined by the gross vehicle weight limitation.

This document does not cover pressure vessels for pressure vessel containers.

NOTE 1 In the context of this document, the term “road tanker” is understood to mean “fixed tanks” and “demountable tanks” as defined in ADR.

NOTE 2 The equipment for the pressure vessels and the inspection and testing after assembly is covered by EN 12252 and EN 14334, respectively.

NOTE 3 The design type of the road tanker is subject to approval by the competent authority, as required by ADR.

NOTE 4 This document is intended for LPG only; however, for other liquefied gases see EN 14025.

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 837-2, *Pressure gauges — Part 2: Selection and installation recommendations for pressure gauges*

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10028-2, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10204, *Metallic products — Types of inspection documents*

EN 12972:2018, *Tanks for transport of dangerous goods — Testing, inspection and marking of metallic tanks*

EN 13445-3, *Unfired pressure vessels — Part 3: Design*

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

EN ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1)*

EN ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles (ISO 3452-1)*

EN ISO 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements (ISO 3834-2)*

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

EN ISO 5173, *Destructive tests on welds in metallic materials — Bend tests (ISO 5173)*

EN ISO 5178, *Destructive tests on welds in metallic materials — Longitudinal tensile test on weld metal in fusion welded joints (ISO 5178)*

EN ISO 5579, *Non-destructive testing — Radiographic testing of metallic materials using film and X- or gamma rays — Basic rules (ISO 5579)*

EN ISO 5817, *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)*

EN ISO 6520-2, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 2: Welding with pressure (ISO 6520-2)*

EN ISO 9016, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination (ISO 9016)*

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 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 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)*

EN ISO 17636-1, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film (ISO 17636-1)*

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

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

EN ISO 17638, *Non-destructive testing of welds — Magnetic particle testing (ISO 17638)*

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

EN ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment (ISO 17640)*

EN ISO 19232-1, *Non-destructive testing — Image quality of radiographs — Part 1: 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 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

3.2
yield strength
upper yield strength ReH or, for steels that do not exhibit a definite yield (non-proportional elongation), the 0,2 % proof strength

3.3
cold forming
forming at temperatures not less than 25 °C below the maximum permissible temperature for stress relieving, in accordance with the applicable material specifications

3.4
hot forming
forming at temperatures above the temperature for stress relieving as stated in the material specifications

3.5
sun shield
shield covering not less than the upper third but not more than the upper half of the shell surface, separated from the shell by an air gap of at least 40 mm

3.6
pressure vessel
assembly of the pressure-retaining envelope (including the openings and their closures) and non-pressure-retaining parts attached directly to it

Note 1 to entry: Also referred to as “tank” in the ADR.

3.7
competent authority
authority or authorities or any other body or bodies designated as such in each State and in each specific case in accordance with domestic law

3.8
inspection body
independent inspection and testing body approved by the competent authority

3.9
competent person
person which by combination of appropriate qualification, training, experience, and resources, is able to make objective judgments on the subject

4 Materials

4.1 Environmental

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

4.2 Suitability

4.2.1 Unless otherwise specified by the design documents, the design temperature range shall be −20 °C to +50 °C.

4.2.2 The materials of construction shall be suitable for operating within the envisaged temperature range. If the pressure vessel could be subjected to more severe lower ambient or product temperatures, the design temperature range shall be −40 °C to +50 °C.

4.2.3 Guidance on selection of material grades is given in Annex A.

4.2.4 If additional impact testing is required, it shall be carried out in accordance with EN ISO 148-1 to achieve the impact values specified in 10.2.5.5.

4.2.5 The materials of the pressure receptacle which are in contact with the contents shall not contain substances liable to substantially weaken the material. The steel grades specified in EN 10028-2 and EN 10028-3, listed in Table A.1, are considered compatible with LPG complying with the limitations on corrosiveness as specified in ISO 9162.

4.3 Pressure retaining parts

Pressure-retaining materials shall be of appropriate steels conforming to EN 10028-2 or EN 10028-3 or shall conform to specifications agreed with the competent authority. All materials shall conform to 10.2.4 and the ratio of the specified yield strength (R_{eH}) to minimum tensile strength (Rm) shall not exceed 0,85 (i.e. $R_{eH}/R\text{m} \leq 0{,}85$). The percentage elongation at fracture shall be not less than 10 000 divided by the actual tensile strength in N/mm², and in any case shall be not less than 16 % for fine grained steels and not less than 20 % for other steels. Where fine grain steels are used, the guaranteed yield strength, R_{eH} shall not exceed 460 N/mm² and the upper tensile strength, R_m, shall not exceed 725 N/mm².

4.4 Non-pressure retaining parts

Non-pressure retaining parts that are directly welded to pressure retaining parts shall be of suitable materials conforming to EN 10025-2 or materials with characteristics approved by a competent authority. All materials used for non-pressure retaining parts shall be compatible with the material of pressure retaining parts, and shall conform to the impact requirements of 10.2.5.5, tested in accordance with the method specified in EN ISO 148-1.

4.5 Welding consumables

Welding consumables shall be able to provide consistent welds with properties at least equal to those specified for the parent materials in the finished pressure vessel.

4.6 Non-metallic materials (gaskets)

Non-metallic materials (gaskets) shall be compatible with both phases of LPG over the range of pressures and temperatures for which the road tanker is designed (see 4.2, Annex B and Annex C).

4.7 Inspection documents for materials

Pressure retaining parts and non-pressure retaining parts directly welded to the pressure vessel shall be provided with the material manufacturers' certificates conforming to EN 10204 certificate type 3.1. Other parts shall have certificates conforming to EN 10204 certificate type 2.2.

5 Pressure vessel design

5.1 Design conditions

5.1.1 The reference temperatures shall conform to Annex B. Where it is authorized by a national competent authority for use within its territory, in accordance with the provision of EU Council Directive 2008/68/EC [13], the reference temperatures designated in Annex C apply.

5.1.2 Design calculations shall be carried out in accordance with Annex D.

5.1.3 Account shall be taken of the fatigue loading on all component parts of the pressure vessel and its attachments by conducting an assessment or through proven operating experience.

5.1.4 The design of the pressure vessel should take into account the following:

— minimizing the use of materials;

— fittings required for efficient operation of the pressure vessel;

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

5.2 Minimum thickness

5.2.1 The minimum thickness for pressure vessels not exceeding a diameter of 1,8 m shall be 5 mm of reference steel [1)]or of an equivalent thickness if in a different steel.

5.2.2 For pressure vessels exceeding a diameter of 1,8 m, the minimum thickness shall be 6 mm of reference steel [1)] or of an equivalent thickness if in a different steel.

[1)] As defined in ADR.

5.2.3 The equivalent thickness shall be calculated using Formula (1):

$$e_1 = \frac{464 e_0}{\sqrt[3]{\left(R_{m1} A_1\right)^2}} \quad (1)$$

where

A_1 minimum elongation at fracture (%) of steel chosen under tensile stress;

e_1 minimum shell thickness in chosen steel, in mm;

e_0 minimum thickness in reference steel, in mm;

R_{m1} minimum tensile strength of steel chosen, in N/mm^2.

5.2.4 The minimum shell thickness shall not be less than the value calculated in accordance with the following Formula (2) [1]:

$$e = \frac{P_T D}{2\sigma} \quad (2)$$

where:

e minimum shell thickness

P_T test pressure in MPa

D internal diameter of shell in mm

σ nominal design stress, as calculated in D.1.1

5.3 Surge plates

5.3.1 Where it is intended that pressure vessels will be operated in excess of 20 % full or less than 80 % full, surge plates shall be fitted. The surge plates shall be designed to permit full internal inspection of the pressure vessel. The volume between any two plates or a plate and the end of the pressure vessel shall not exceed 7 500 l.

5.3.2 The distance between surge plates shall not exceed 4 m.

5.3.3 The area of each surge plate shall be at least 70 % of the cross-sectional area of the pressure vessel in which the plates are fitted.

5.3.4 Surge plates shall be able to withstand the load imposed by a full capacity liquid content of the section between the plates in either direction.

5.3.5 Surge plates shall be at least 2 mm thick.

5.3.6 Provision shall be made for communication and drainage between sections.

5.4 Doubler plates

To reduce stress concentration on the pressure vessel, load-carrying attachments shall incorporate a doubler plate between the attachment and the pressure vessel shell.

Non-circular doubler plates shall be designed with as generous as practicable corner radii (minimum radius 25 mm) to reduce stress concentrations.

Doubler plates shall be provided with vent holes or test sockets which shall be closed after testing.

5.5 Stresses due to motion

Pressure vessels and their permanent attachments shall be able to absorb, under maximum permissible load, forces exerted by the design pressure, and the following dynamic forces:

— in the direction of travel: twice the total mass;

— at right-angles to the direction of travel: the total mass;

— vertically upwards: the total mass;

— vertically downwards: twice the total mass.

Under the forces defined above, the stresses in the pressure vessel and its fastenings shall not exceed the following:

a) general membrane stress in the shell, remote from the supports:

   — the normal design stress as defined in D.1;

b) stresses local to the supports, determined either by experimental analysis or calculation/special analysis:

   — the limits specified in EN 13445-3.

5.6 Self-supporting pressure vessels

Self-supporting pressure vessels shall be designed to carry bending stresses that would otherwise be carried by the chassis or frame.

5.7 Vacuum conditions

Pressure vessels shall be designed to withstand vacuum conditions generated by the product during operation or other operational conditions, but as a minimum, this shall be equivalent to an external pressure of at least 40 kPa (0,4 bar) gauge pressure.

Suitable design methods may be applied from EN 13445-3.

NOTE Some liquefied petroleum gases have vapour pressures below atmospheric pressure at temperatures that could occur during normal operations in winter, and this could create partial vacuum conditions within the carrying pressure vessel.

5.8 Pressure vessel mountings

5.8.1 Mounting structures shall be fabricated in steel and designed to limit movement of the pressure vessel in relation to the chassis.

5.8.2 Pressure vessel mountings and their method of attachment to the shell shall be of sufficient strength to support the pressure vessel when full of water.