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Automotive LPG components - Containers

Bauteile für Autogasanlagen/Treibgasanlagen - Autogastanks

Composants pour véhicules au GPL - Réservoirs

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Bauteile für Autogasanlagen/Treibgasanlagen - Autogastanks

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Foreword

This document EN 12805:2002 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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.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 EU Directive(s).

Annexes A, B, K and L are informative, annexes C to J are normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard defines requirements for the design, manufacturing and testing of welded steel automotive Liquefied Petroleum Gas (LPG) containers.

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 execution of its provisions is entrusted to appropriately qualified and experienced people.

1 Scope

This European Standard specifies the requirements for design, manufacturing and testing of welded steel automotive Liquefied Petroleum Gas (LPG) containers, to be permanently attached to a motor vehicle, where the automotive LPG is to be used as a fuel in the vehicle.

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 287-1, *Approval testing of welders - Fusion welding – Part 1: Steels.*

EN 288-3, *Specification and approval of welding procedures for metallic materials - Part 3: Welding procedure tests for the arc welding of steels.*

EN 589, *Automotive fuels - LPG - Requirements and test methods.*

EN 876, *Destructive test on welds in metallic materials - Longitudinal tensile test on weld metal in fusion welded joints.*

EN 895, *Destructive tests on welds in metallic materials – Transverse tensile test.*

EN 910, *Destructive tests on welds in metallic materials - Bend tests.*

EN 1435, *Non-destructive examination of welds - Radiographic examination of welded joints.*

EN 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature.*

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

EN 22768-1, *General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1:1989).*

EN ISO 6507-1, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1:1997).*

EN ISO 7438, *Metallic materials - Bend test (ISO 7438:1985).*

EN ISO 7799, *Metallic materials - Sheet and strip 3 mm thick or less - Reverse bend test (ISO 7799:1985).*

ISO 1106-1, *Recommended practice for radiographic examination of fusion welded joints - Part 1: Fusion welded butt joints in steel plates up to 50 mm thick.*

ISO 2504, *Radiography of welds and vewing conditions for films - Utilization of recommended patterns of image quality indicators (I.Q.I.).*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
test pressure
pressure to which the container is subjected during the test procedure

3.1.2
design pressure
pressure on which the calculations are based

3.1.3
working pressure
pressure under normal operating conditions

3.1.4
container
vessel used for the storage of automotive LPG

3.1.5
cylindrical container
container with a cylindrical shell and two dished ends, either torispherical or elliptical

3.1.6
special container
container other than the cylindrical container

3.1.7
type of containers
container or a group of containers where the individual container does not differ significantly with respect to the following conditions:

— the manufacturer (different trade names or marks possible);

— the shape;

— the openings;

— the material;

— the welding process;

— the heat treatment;

— the production line;

— the diameter;

— height (in case of a special container);

— the nominal wall thickness

3.1.8
stress relieving
heat treatment given to objects to reduce the residual stresses without altering the metallurgical structure of steel, by heating to a uniform temperature, Ac_1, and cooling in a controlled atmosphere

3.1.9
normalising
heating to a uniform temperature, Ac_3, of the steel and then cooling in a controlled atmosphere

3.1.10
hot-rolled
deformation of the material at the critical temperature Ac_3

NOTE Ac_1 and Ac_3 will be obtained from the material data sheet.

3.1.11
longitudinal weld
weld over the full length of the shell or cylindrical part of the shell, excluding welds for fittings

3.1.12
batch
number of containers made under the same process, that belong to the same family

3.1.13
parent material
material in the state before any specific transformation with regards to the container manufacturing process

3.1.14
Liquefied Petroleum Gas (LPG)
mixture of light hydrocarbons, gaseous under normal atmospheric conditions which can be liquefied by increased pressure or decreased temperature. The main components are propane, propene, butane and butene isomers

3.1.15
automotive LPG
motor fuel complying with EN 589

3.2 Symbols and abbreviations

a is the minimum calculated wall thickness of the cylindrical shell in mm,

b is the minimum calculated wall thickness of the dished ends in mm,

e is the actual wall thickness,

C is the shape factor,

D is the nominal outside diameter of the container in mm,

F is the force in N,

g is the gravity in m/s^2,

h is the height of cylindrical part of dished end in mm,

H is the outside height of dished part of container end in mm,

P_b is the maximum pressure measured in the burst test in kPa,

P_h is the hydraulic test pressure /design pressure in kPa,

r is the inside knuckle radius of the dished end of the standard cylindrical container in mm,

R is the inside dish radius of the dished end of a standard cylindrical container in mm,

R_e is the minimum yield stress in N/mm^2 guaranteed by the material standard,

R_m is the minimum tensile strength in N/mm^2 guaranteed by the material standard,

z is the welding factor,

HV is the Vickers hardness,

PRV is the pressure relief valve,

PRD is the pressure relief device or fuse.

4 Technical requirements

4.1 General provisions

The container for vehicles using automotive LPG in their propulsion system shall function in a correct and safe way.

The materials of the container shall be compatible with LPG.

All necessary corrosion prevention measures shall be taken to protect the finished container including any permanently fixed parts.

4.2 Dimensions

For all dimensions without indication of tolerances, general tolerances of EN 22768-1 shall apply.

4.3 Steel

Steel for shells, dished ends, welded plates and rings (see annex D) shall be in accordance with EN 10120. Steels other than those in EN 10120 may be used, provided that the container complies with the requirements of this standard.

The container manufacturer shall ensure that all parent materials are free from defects.

Container parts shall be made of materials that are compatible when welded.

The filler materials shall be compatible with the material to form welds with properties equivalent to those specified for the parent material (see EN 288-3).

The container manufacturer shall obtain and provide chemical cast analysis certificates and mechanical properties of the steel used for the construction of the parts subject to pressure.

The container manufacturer shall maintain a system for identification in the fabrication so that all parent materials for parts subject to pressure can be traced.

The container manufacturer shall maintain records of the results of metallurgical and mechanical tests and analyses of parent and filler materials.

4.4 Design temperature

The minimum design temperature shall be – 20 °C.

The maximum design temperature shall be + 65 °C.

For extreme operating temperatures, exceeding the above, a minimum design temperature of – 40 °C shall be applied.

4.5 Design pressure

The design pressure of the container shall be 3 000 kPa.

4.6 Heat treatment

The container manufacturer shall maintain records to demonstrate that the containers have been adequately heat treated.

Localised heat treatment of a completed container shall not be permitted.

The heat-treatment shall be according to the following:

a) containers with a wall thickness greater than or equal to 5 mm:

— for hot-rolled and normalized material: stress relieving or normalizing;

— for material of a different kind: normalizing;

b) containers with a wall thickness less than 5 mm:

— normalizing the whole container, or

— normalizing the parts having been deformed by more than 5 %.

Heat treatment shall not be required if, in a tensile test carried out after forming by a standard procedure in accordance with EN 10002-1, the elongation after rupture is 14 % or more.

4.7 Calculation of the parts under pressure

4.7.1 Wall thickness of the cylindrical shell

The minimum wall thickness *a* of the cylindrical shell shall be calculated according to the following calculation:

– containers without a longitudinal weld:

$$a = \frac{P_h D}{1500 R_e + P_h}$$

– containers with a longitudinal weld:

$$a = \frac{P_h D}{1500 R_e z + P_h}$$

For the value *z* see 5.2.4.2.

4.7.2 Non-cylindrical containers

For container shapes other than a cylindrical container the adequacy of their design shall be shown by a calculation or demonstrated by a fatigue test in accordance with 7.6 or by appropriate stress analysis. All welding requirements for cylindrical containers shall apply.

4.7.3 Container ends

Container ends shall be in one piece, concave to the pressure, and shall be either torispherical or semi-ellipsoidal.

The minimum wall thickness *b* of the ends after forming shall be calculated according to the following formula:

$$b = \frac{P_h D}{1\,500 R_e} C$$

The shape factor C shall be obtained from Table J.1 or Figure J.1 or Figure J.2.

The difference between the wall thickness of the cylindrical edge of the ends and the shell shall be 15 % or less of the smallest wall thickness.

The dimensions of the container ends shall fulfil the following conditions:

NOTE For illustration of container ends, see annex B.

— Torispherical ends:

$r \geq 0{,}1\ D$

$R \leq D$

$r \geq 2\ b$

$h \geq 4\ b$

$H \geq 0{,}18\ D$

$0{,}003\ D \leq b \leq 0{,}080\ D$

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

$h \leq 0{,}15\ D$

— Semi-ellipsoidal ends:

$H \geq 0{,}1\ D$

$h \geq 4\ b$

$0{,}003\ D \leq b \leq 0{,}080\ D$

$h \leq 0{,}15\ D$

5 Construction and workmanship

5.1 General requirements

The manufacturer shall be able to demonstrate that his quality control system ensures that the containers produced meet the requirements of this standard.

The manufacturer shall maintain records of the welding procedures and inspections that are carried out during production.

The manufacturer shall visually examine the pressure containing parts of the container before assembly.

5.2 Welding requirements

5.2.1 Welding qualifications

The manufacturer shall qualify the welding procedures and welders before proceeding with the production of containers to EN 288-3 and EN 287-1 respectively.

The manufacturer shall maintain records of his welding qualifications.

5.2.2 Technical welding requirements

Butt welds shall be executed by an automatic or semi-automatic welding process.

Butt welds on the pressure containing shell shall not be located in any areas where there are changes of profile.

Angle (fillet) welds shall be at least 10 mm away from butt welds.

Welded attachment points in the area of the small radius r of ends are permitted if the container fulfils the requirements of the burst test.

Container welds shall satisfy the following:

— a longitudinal weld shall be in the form of a butt weld on the full section of the wall, see Figure C.1;

— a circumferential weld shall be in the form of a butt weld on the full section of the wall, see Figure C.2;

NOTE 1 A joggle weld is considered to be a special type of butt weld.

— a weld attaching the valve boss/plate or ring to the container shall be in accordance with annex D;

— a weld attaching a collar or support to the container shall be either a butt or an angle weld;

— misalignment of the joint-faces of a butt weld shall not exceed 20 % of the wall thickness.

Welded mounting supports shall be welded circumferentially. Welds shall be strong enough to withstand vibrations and forces of at least 30 *g* in all directions, to be demonstrated by impact test or calculation.

NOTE 2 For details, see EN 12979.

5.2.3 Shift rotating of welds

When the cylindrical part of the container is made of two or more parts, the longitudinal welds shall not be aligned and the distance between the welds shall be at least 10 times the wall thickness of the container, see annex E.