BS EN 12252:2014

BSI Standards Publication

LPG equipment and accessories — Equipping of LPG road tankers

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National foreword

This British Standard is the UK implementation of EN 12252:2014. It supersedes BS EN 12252:2012 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/19, LPG containers and their associated fittings.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Foreword

This document (EN 12252:2014) 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of an identical text or by endorsement, at the latest by October 2014 and conflicting national standards shall be withdrawn at the latest by October 2014.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 12252:2012.

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

This document has been submitted for reference into the technical annexes of the ADR [9].

NOTE These regulations take precedence over any clause of this European Standard. It is emphasised that RID/ADR/ADN are being revised regularly at intervals of two years which might lead to temporary non-compliances with the clauses of this European Standard.

The main technical changes of this revision include:

— the update of definitions;

— the modification of requirements on the primary shut-off system (see 6.1.3);

— the modification of the general requirements on the safety system (see 11.1);

— the correction of an error in the flow calculation units (see Annex A).

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 may be injurious to health and also 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 around the world. Protection of the environment in this document is understood in a very broad sense. The phrase is used, for example, in relation to the total life-cycle aspects of a product on the environment, including expenditure of energy, and during all phases of its existence, from mining of raw materials, fabrication, packaging, distribution, use, scrapping, recycling of materials, etc.

NOTE 1 Annex C comprises an environmental checklist which highlights the clauses of this European Standard that address environmental issues.

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

It is recommended that manufacturers develop an environmental management policy. For guidance see the ISO 14000 series [3], [4] and [5]

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.

NOTE 2 This European 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 might be beneficial to refer to the leaflet “measurement uncertainty leaflet” SP INFO 2000 27 [10].

1 Scope

This European Standard specifies equipment and accessories for road tankers used for the transport of Liquefied Petroleum Gas (LPG) and identifies the equipment that is considered necessary to ensure that filling, transportation and discharge operations can be carried out safely. It specifies the requirements for the assembly of the accessories and the vehicle LPG equipment to the road tanker. This European Standard also identifies additional equipment and accessories that can be used on road tankers carrying LPG.

This European Standard does not preclude the use of alternative designs, materials and equipment testing which provide the same or a higher level of safety. ADR [9] requires that such alternative technical codes be recognised by the competent authority, provided that the minimum requirements of section 6.8.2 of ADR [9] are complied with.

This European Standard does not apply to “tank-containers” or “battery-vehicles” used for the transport of LPG.

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 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 558, *Industrial valves — Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems — PN and Class designated valves*

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

EN 1012-1, *Compressors and vacuum pumps — Safety requirements — Part 1: Air compressors*

EN 1591-1, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation method*

EN 1762, *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa) — Specification*

EN 1983, *Industrial valves — Steel ball valves*

EN 1984, *Industrial valves — Steel gate valves*

EN 10025 (all parts), *Hot rolled products of structural steels*

EN 10028 (all parts), *Flat products made of steels for pressure purposes*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 12074, *Welding consumables — Quality requirements for manufacture, supply and distribution of consumables for welding and allied processes*

EN 12493, *LPG equipment and accessories — Welded steel pressure vessels for LPG road tankers — Design and manufacture*

EN 12627, *Industrial valves — Butt welding ends for steel valves*

EN 12760, *Valves — Socket welding ends for steel valves*

EN 13175, *LPG equipment and accessories — Specification and testing for Liquefied Petroleum Gas (LPG) tank valves and fittings*

EN 13709, *Industrial valves — Steel globe and globe stop and check valves*

EN 13789, *Industrial valves — Cast iron globe valves*

EN 13799, *LPG equipment and accessories — Contents gauges for Liquefied Petroleum Gas (LPG) pressure vessels*

EN 14422, *Clamp type coupling assemblies for liquefied petroleum gas (LPG) transfer hoses*

EN 14424, *Hose fittings with screwed ferrules*

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

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

EN ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements (ISO 3834-3)*

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

EN ISO 10497, *Testing of valves — Fire type-testing requirements (ISO 10497)*

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)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 and butene with traces of other hydrocarbon gases

3.2
pressure vessel
assembly of the pressure-retaining envelope (including the openings and their closures) and non-pressure-retaining parts attached directly to it

3.3
primary shut-off system
valve or a series of valves attached to the pressure vessel which provides a method of sealing off the flow from the pressure vessel

3.4
vehicle LPG equipment
equipment and pipework on the road tanker which is in contact with LPG and forms part of the LPG operating system, shut-down system or safety system, but which is not directly connected to the pressure vessel and is not part of the automotive LPG system

3.5
accessories
device connected to the system the main function of which is not for the storage or conveyance of LPG

Note 1 to entry: Referred to as “service and structural equipment” in ADR [9].

3.6
thermowell
permanently sealed pocket in the vessel/pipework for the temperature gauge

3.7
pipework
pressure containing enclosure used for the conveyance of LPG, consisting of pipe, pipe fittings, valves and other accessories

3.8
road tanker
vehicle with a fixed or demountable pressure vessel (tank) having only one compartment

Note 1 to entry: Road tankers are referred to as fixed tanks (tank-vehicles) and demountable tanks in the ADR [9].

3.9
thermal expansion valve
self-closing valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges fluid at a predetermined pressure

3.10
non-return valve
valve designed to close automatically to restrict reverse flow

3.11
excess flow valve
valve designed to close automatically, with a small residual flow, when the fluid flow passing through it exceeds a predetermined value, and to re-open when the pressure differential across the valve has been restored below a certain value

3.12
shut-off valve
valve to provide a leak-tight seal which is operated either manually, remotely or is self-closing

3.13
pressure relief valve
PRV
self-closing valve which automatically, without the assistance of any energy other than that of the vapour concerned, discharges vapour at a predetermined pressure, and operates with a pop action

3.14
design pressure
DEPRECATED: calculation pressure
pressure used for the calculation of the minimum wall thickness

3.15
gas-free
less than 20 % of the lower explosive limit of LPG in air

3.16
competent person
person which by combination of appropriate qualification, training, experience, and resources, is able to make objective judgments on the subject

3.17
fixed liquid level gauge
gauging device used to indicate when a predetermined liquid level has been reached or surpassed, i.e. a dip tube in combination with a vent valve

3.18
competent authority
authority designated as competent in each country in accordance with national regulations

4 Requirements

4.1 General

4.1.1 The complete road tanker, its equipment and accessories, shall withstand the anticipated mechanical, chemical and thermal stresses without leakage of LPG.

NOTE ADR [9] requires that each new design of a road tanker (tank vehicle) including equipment to be approved by the competent authority.

4.1.2 Equipment and accessories shall be:

— protected against accidental damage where such damage could lead to an unintended escape of LPG;

— able to withstand dynamic stresses due to motion;

— suitably protected if the road tanker rolls over;

— arranged and protected against being wrenched off or damaged during operation;

— suitable to withstand thermal expansion and contraction, mechanical shock and vibration;

— designed to keep openings in the pressure vessel and associated pipework and accessories to a minimum; all other openings shall be fitted with suitable blanking plugs or flanges; and

— manufactured from materials which give the finished equipment the required mechanical properties, in particular, where equipment is subject to the low temperatures (including low temperatures caused by filling), suitably ductile material shall be used.

4.1.3 It is recommended that materials and components be acquired from suppliers who have a declared environmental policy (see EN ISO 14021, EN ISO 14024 and EN ISO 14025).

4.2 Equipment

Mandatory and optional equipment to be fitted to LPG road tankers shall be in accordance with Table 1.

Table 1 — Road tanker equipment

Description	Clauses	Mandatory	Optional
Accessories			
Contents gauge	6.1.1 / 8.2	X	
Pressure gauge	6.1.2 / 8.3	X	
Primary shut-off system	6.1.3	X	
Temperature gauge	6.2 / 8.4		X
Pressure relief valve (PRV)	6.2 / 8.11		X
Sun shield	6.2		X
Vehicle LPG equipment			
Pipework	7.1.2 / 8.1.6	X	
Emergency shut-down system	11.2	X	
Hoses	7.1.3 / 8.6	X	
Thermal expansion valves	7.1.4	X	
Valves	8.10	X	
Compressor	7.2		X
Pump	7.2 / 8.5		X
Hose reel	7.2 / 8.7		X
Metering system	7.2 / 8.9		X
Earth connection	7.1.5	X	
Earth reel	7.2 / 8.8		X

4.3 Valve access

Valves required for normal and emergency operation shall be readily accessible or remotely operated.

5 Pressure vessel

5.1 Design and manufacture

The pressure vessel shall be designed and manufactured in accordance with EN 12493 or an equivalent standard.

5.2 Mounting of pressure vessel on road tanker

5.2.1 General

The pressure vessel and fastenings to the structure of the road tanker shall be designed and constructed to absorb safely the stresses from normal use such as surge, vibration, braking action etc.

5.2.2 Mounting

5.2.2.1 The fixing of the pressure vessel to the road tanker shall be designed in accordance with a calculation based on the forces given in Table 2.

NOTE A sample method of calculation for the mountings of the pressure vessel to the chassis is contained in Annex B.

5.2.2.2 The pressure vessel shall be electrically continuous with the chassis. The resistance of this electrical path shall not exceed 10 Ω.

5.2.2.3 Where the pressure vessel, while on the chassis, will be subjected to a hydraulic test, during which the pressure vessel can contain 2,4 times the normal mass of its normal operating capacity, it shall be established that the chassis is capable of taking this mass without additional support.

Table 2 — Forces for fixing the pressure vessel to the road tanker

Direction of force	Force N
In the direction of travel	2 *g* × total mass of pressure vessel
At right angles to the direction of travel	1 *g* × total mass of pressure vessel
Vertical, upwards	1 *g* × total mass of pressure vessel
Vertical, downwards	2 *g* × total mass of pressure vessel
The total mass of the pressure vessel shall be taken as the tare mass plus the maximum allowable mass of the contents. NOTE *g* = gravitational acceleration.	

6 Pressure vessel accessories

6.1 Required pressure vessel accessories

6.1.1 Contents gauge

6.1.1.1 Pressure vessels shall be equipped with a suitable contents gauge. The requirements of EN 12493 for maximum fill shall apply.

6.1.1.2 Where the contents of the pressure vessel are to be measured by volume rather than by mass, at least two independent systems of measuring the contents shall be fitted, only one of which can be a fixed liquid level gauge.

6.1.2 Pressure gauge

Pressure vessels shall be equipped with a pressure gauge in accordance with 8.3.

6.1.3 Primary shut-off system

6.1.3.1 The road tanker shall have three mutually independent shut-off devices for each bottom filling or discharge opening.

The first shall be a stop-valve mounted inside the pressure vessel (see 6.1.3.3 a)).

Filling connections piped into the vapour space of the pressure vessel can use a spring loaded (held closed by the spring) soft seat non-return valve as the first stop-valve.

The second shall be an external stop-valve which shall be mounted at the end of each pipe.

The third shall be in the form of a blanking flange or cap.

The position and/or direction of closure of valve type shut-off devices shall be clearly apparent.

6.1.3.2 All connections to the pressure vessel in excess of 1,5 mm diameter, other than those for pressure relief valves or those permanently fitted with blank flanges or plugs, shall incorporate a primary shut-off system.

6.1.3.3 The primary shut-off system shall be designed to:

a) prevent the unintended opening of the internal valve through damage or inadvertent acts;

b) protect the internal stop-valve from external stresses;

c) allow pressure to be safely released before the blanking flanges or plugs are completely removed; and

d) allow filling and discharge devices/caps to be secured against unintended opening.

6.1.3.4 The primary shut-off system required depends upon the purpose of the pressure vessel connection as follows:

a) Discharge/filling to liquid phase:

   A normally closed internal shut-off valve opened by hydraulic, pneumatic or mechanical power from the road tanker shall be designed for rapid closure on command (see 11.2). The system shall incorporate a thermally sensitive device or other means that will ensure positive closure in the event of a fire and shall incorporate an excess flow valve facility. The operation of the internal valve shall be completely independent of any other valve and the valve shall remain effective in the event that the external manual valve is damaged.

b) Filling to vapour phase:

   The road tanker filling connection shall be provided with either:

   1) an internal, soft seat spring loaded (held closed by the spring) non-return valve in series combination with an external manual shut-off valve, or

   2) a normally closed internal shut-off valve opened by hydraulic, pneumatic or mechanical power from the road tanker along with an anti-drive-away system/emergency-shut down system in series combination with an external manual shut-off valve. The operation of the internal valve shall be completely independent of any other valve and the valve shall remain effective in the event that the external manual valve is damaged.

c) Other liquid or vapour piped connections:

All other liquid or vapour connections shall have an internal excess flow valve or internal non-return valve in series combination with a manual shut-off valve with the exception of the following:

1) pressure relief valve;

2) permanently blanked; and

3) connections with an internal bore no larger than 1,5 mm diameter.

6.2 Optional pressure vessel accessories

Where any of the optional accessories are fitted (see Table 1), the following requirements shall apply:

a) temperature gauges shall be in accordance with 8.4;

b) pressure relief valves (PRV) shall be sized in accordance with 8.11 and Annex A;

c) sun shields shall satisfy the requirements of EN 12493.

7 Vehicle LPG equipment

7.1 Mandatory LPG equipment

7.1.1 General

Vehicle LPG equipment and accessories shall be protected against mechanical damage, by its design or location and/or by barriers.

7.1.2 Pipework

Mechanical barriers shall not be attached to pipework or to the accessories which they are intended to protect. The pipework shall be installed so as to prevent damage due to thermal expansion and contraction, mechanical shock and vibration.

The number of joints shall be kept to a minimum. Joints shall be welded or weld flanged except if permitted by 9.4.

7.1.3 Connecting hoses

Connecting hoses for pipework/equipment shall be in accordance with 8.6.

7.1.4 Accessories

7.1.4.1 Thermal expansion valves

Thermal expansion valves shall be provided for all pipework sections where liquid can be trapped between closed valves unless the system is otherwise protected.

Thermal expansion valves shall be positioned so that they do not point at the LPG pressure vessel; nor shall they be placed in the bottom quarter of horizontal pipework.

Thermal expansion valves shall be set to discharge at a pressure not above the design pressure of the equipment being protected.

7.1.4.2 Valves

A shut-off valve is required in the pipework for liquid transfer or vapour balance connections used for routine operations. It shall be positioned as close as reasonable to the end of the pipework and/or hose outlet.

Valves shall be in accordance with 8.10.

7.1.5 Earth connection

A suitably marked earth connection shall be provided, clearly marked with the earth symbol in Figure 1.

Figure 1 — Earth symbol

7.2 Optional LPG equipment

Where any of the following equipment is fitted to the road tanker, the following requirements shall apply:

— compressors shall be in accordance with EN 1012-1;

— pumps shall be in accordance with 8.5;

— delivery hoses shall be in accordance with 8.6;

— hose reels shall be in accordance with 8.7;

— earth reels shall be in accordance with 8.8; and

— metering systems shall be in accordance with 8.9.

8 Equipment specifications

8.1 Suitable materials

8.1.1 General

Unless otherwise specified by the design documents, the design temperature range shall be –20 °C to +50 °C. The materials of construction shall be suitable for operating within the envisaged temperature range. Where the road tanker could be subjected to more severe ambient or product temperatures, the design temperature range shall be –40 °C to +50 °C.

Guidance on selection of material grades is given in EN 12493.

8.1.2 Steel pressure retaining parts

Steel pressure-retaining materials shall be of appropriate steels conforming to EN 10028 (all parts).

8.1.3 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 (all parts) or materials, which are demonstrably equivalent, and shall be compatible

with the material of pressure retaining parts. They shall be tested in accordance with the method specified in EN ISO 148-1.

8.1.4 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 part and shall be in accordance with EN 12074.

8.1.5 Non-metallic materials

8.1.5.1 Non-metallic materials shall be compatible with both phases of LPG over the range of pressures and temperatures for which the vehicle LPG equipment is designed.

8.1.5.2 Non-metallic materials shall also comply with the appropriate requirements of EN 549.

8.1.5.3 All elastomeric materials in contact with LPG shall meet the specific requirements of EN 549 for resistance to the following:

a) gas (pentane test);

b) lubricants;

c) ageing;

d) low temperature;

e) high temperature;

f) compression;

g) ozone (where gasket/seal is exposed to atmosphere).

NOTE For guidance on the choice of non-metallic materials, see EN ISO 11114-2.

8.1.6 Pipework

Pipes shall be in accordance with either or both EN 10216-1 and EN 10217-1.

8.1.7 Certification of materials

Pressure retaining parts and non-pressure retaining parts directly welded to pressure containing parts shall be provided with material manufacturers' certificates conforming to EN 10204:2004, certificate type 2.2.

8.1.8 Control of materials

8.1.8.1 The manufacturer shall maintain a system of identification for the material used in the fabrication to ensure that all material for pressure-retaining parts and non-pressure-retaining parts directly welded to pressure-retaining parts in the completed work can be traced to their origin. The system shall incorporate appropriate procedures for verifying the identity of material received from the supplier.

8.1.8.2 Verifying procedures shall be based on the material manufacturers' certificates and/or acceptance tests.

8.1.8.3 Details of welding consumables shall be retained.

8.2 Contents gauge

8.2.1 Pressure vessels shall be equipped with a suitable contents gauge in accordance with EN 13799. All materials in direct contact with LPG, except for seals, shall be metallic.

8.2.2 The bleed hole maximum opening shall not be larger than 1,5 mm diameter unless it is protected by a shut-off valve and a suitable excess flow valve.

8.2.3 The operational bleed screw shall remain captive at all times.

8.2.4 It shall be possible to replace the gland without withdrawing the pressure vessel from service.

8.2.5 The design of any rotary gauging device shall consider the effects of transport vibrations.

8.2.6 Where used, rotary gauges shall be free to move in both clockwise and anti-clockwise directions.

8.3 Pressure gauge

8.3.1 The pressure gauge shall be located so that it is protected from damage and can be easily monitored.

8.3.2 Where a gauge is connected directly to the pressure vessel, the requirements of 6.1.3.1 shall apply.

8.3.3 Pressure gauges shall be in accordance with EN 837-2.

8.4 Temperature gauge

8.4.1 The connection for a temperature gauge to pipework or pressure vessel shall be made by a thermowell (a sealed pocket to prevent direct contact between the temperature gauge probe and the LPG).

8.4.2 The thermowell shall be constructed in accordance with the same design requirements as the pressure vessel or pipework into which it is permanently fixed.

8.5 Pump

8.5.1 Where the pump is driven by the drive shaft or road tanker engine, the rotational speed of the drive shall be variable with controls to prevent the rating of the pump being exceeded.

8.5.2 For a positive displacement pump in addition to any internal pump overload by-pass, the pump or outlet pipework shall be fitted with a separate by-pass valve set at a lower differential pressure to automatically carry any excess liquid back to the pressure vessel when the delivery valve is closed. The by-pass valve shall be suitably sized to accommodate the pump discharge flow rate.

8.5.3 Where a pump minimum flow by-pass system is not provided, the design and operation shall ensure that cavitation is avoided.

8.5.4 A suitable strainer shall be fitted upstream of the pump inlet, where required by the pump manufacturer. Where the strainer does not protect the pump during uplift, provision for a second strainer shall be made.

8.5.5 Pumps shall be equipped with a sealing of high quality; simple stuffing boxes are not permissible.

8.6 Hoses

8.6.1 The road tanker discharge hose shall be in accordance with EN 1762.

8.6.2 Hose couplings shall be in accordance with EN 13175, EN 14422 or EN 14424.

8.6.3 The road tanker discharge hose shall be made of material suitable for LPG service and designed for a pressure at least equal to the design pressure of the pipework. Hoses shall be in one manufactured length without intermediate joints or couplers and shall not exceed 60 m.

8.6.4 The road tanker discharge hose end valves shall be protected against inadvertent opening and shall have a suitable secure storage location to prevent movement when the road tanker is in motion.

8.6.5 The road tanker discharge hose with their couplings shall be tested to a pressure of 1,5 times its design pressure.

8.6.6 The minimum bend radius of the road tanker discharge hose shall be less than the bend radius of the hose reel when fitted.

8.6.7 The road tanker discharge hose and hose fittings in use in the different EU countries are acceptable when they conform to a relevant national specification.

8.7 Hose reel

8.7.1 The hose reel shall be fitted with a brake assembly to allow control of the speed of the reel.

NOTE The placement of roller or spool assemblies at or near the hose reel is suited to prevent tearing or wear of the hoses by sharp edges.

8.7.2 The hose reel shall have either manual or power rewind. The power rewind shall be designed to prevent damage due to excessive rewinding.

8.8 Earth reel

The earth reel shall have electrical continuity with the pressure vessel.

8.9 Metering system

8.9.1 The design and materials of construction shall be suitable for use with liquid LPG and the service conditions.

8.9.2 Cast iron shall not be used unless it has adequate ductility and resistance to brittle failure over the range of pressures and temperatures to which it may be subjected in use.

8.9.3 Ductile iron with an elongation at fracture of less than 18 % shall not be used.

8.10 Valves

Valves for vehicle LPG equipment shall comply with one or more of the following:

— EN 13175,

— EN 558,

— EN 1983,

— EN 1984,

— EN ISO 10497,

— EN 12627,

— EN 12760,

— EN 13789,

— EN 13709.

8.11 Pressure relief valves (PRV)

8.11.1 PRVs shall be located in the vapour space of the pressure vessel.

8.11.2 The PRVs shall be spring loaded and designed to resist dynamic stresses, including liquid surge.

NOTE PRV settings are specified by ADR [9].

8.11.3 The sizing and number of PRVs should be in accordance with Annex A.

8.11.4 PRVs shall be sited flush with the pressure vessel shell and with the operating mechanism inside the pressure vessel, or any protrusion shall be adequately guarded against impact damage and any damage to the guard shall not interfere with the satisfactory operation of the valve.

9 Assembly

9.1 General

Road tankers shall be equipped according to drawings and specifications by competent persons.

9.2 Welding

9.2.1 Welding of the pressure containing parts

9.2.1.1 Welding of the pressure containing parts shall conform to EN ISO 3834-2 and EN ISO 3834-3.

9.2.1.2 Welding of the pressure containing parts shall only be carried out when all the following apply:

— A welding procedure specification is compiled by the manufacturer. The welding procedures selected by the manufacturer are qualified for the application. The manufacturer has compiled a welding procedure specification for each joint or family of joints in accordance with EN ISO 15609-1. Welding procedures are qualified by welding procedure tests conforming to EN ISO 15614-1.

— The welders are qualified for the work in accordance with EN ISO 9606-1 and welding operators in accordance with EN ISO 14732, and their approval is valid.

— A list of welders and welding operators and records of approval tests are maintained by the manufacturer.

NOTE Recommended weld details are given in EN 1708–1.

9.2.1.3 The environmental impact of welding and allied processes should be assessed in accordance with EN 14717.

9.2.2 Welding of the non pressure containing parts

Welding of the non-pressure containing parts and welding of attachments (temporary or otherwise), including supports, to a pressure retaining part shall follow a qualified procedure.

9.3 Flanged connections

The number of flanged connections shall be minimised. Flanges and their joints shall be designed in accordance with EN 1591-1.

NOTE For selection of flanges see EN 1092–1 or ISO 7005-1.

9.4 Screwed connections

Connections for pipework up to and including 50 mm nominal bore, or for proprietary items such as pumps, valves and metres up to 80 mm nominal bore, can be threaded.

9.5 External corrosion protection

Road tanker LPG equipment shall have sufficient external protection against corrosion arising from atmospheric effects.

10 Inspection and testing

10.1 General

Pressure vessels of road tankers and their equipment are required by ADR [9] to undergo, either together or separately, an initial inspection and testing before being put into service by inspection bodies approved by the competent authority.

These inspections and tests are required by ADR [9] to include:

— a check of conformity to the approved type;

— a check of the design characteristics;

— an examination of the internal and external conditions;

— a hydraulic pressure test;

— a leakproofness test;

— a check of satisfactory operation of the equipment.

The tests in 10.2 and 10.3 are part of the ADR [9] requirements.

10.2 Hydraulic pressure test

10.2.1 On completion of construction, road tanker pipework shall be subjected to a hydraulic pressure test at a test pressure of 1,3 times the design pressure specified in the pipework design document or 1,3 times the test pressure of the pressure vessel, whichever is the greatest.

NOTE ADR requires that the use of a gas for the hydraulic pressure test is agreed with the competent authority.

10.2.2 The first pressurisation shall be carried out under controlled conditions with appropriate safety precautions.

10.2.3 Care shall be taken with the disposal of the liquid to avoid environmental contamination.

10.2.4 Attempts should be made to maximise the amount of liquid recycled for repeated use in hydraulic tests.

10.3 Leak test

10.3.1 Following the hydraulic pressure test in 10.2 and final assembly, the road tanker LPG pressure vessel and equipment shall undergo a leak test as a complete assembly.

10.3.2 The leakproofness test shall be carried out at low pressures.

10.3.3 Where the pressure vessel is gas-free, the leakproofness test pressure shall be not less than 20 % of the vessel test pressure using air or nitrogen (or any other fluid compatible with the materials of the pressure vessel and/or the item/section to be tested).

10.3.4 Where the pressure vessel is in gas service, the leakproofness test pressure shall be not less than 20 % of the vessel test pressure carried out using the LPG vapour pressure.

11 Safety systems

11.1 General

11.1.1 A system shall be provided which will prevent the road tanker from being moved unintentionally while any of the following conditions apply:

a) the LPG pump is running;

b) the liquid fill or discharge internal shut-off valve is open;

c) the master switch is isolated;

d) the discharge hose is not fully retracted.

11.1.2 The internal valves of the filing and discharge systems shall automatically close in the event of fire.

11.1.3 The following safety systems may be provided:

a) remote shut-off activated by radio (see 11.2);

b) Emergency Shut-Down system (ESD) or drive away protection, activated by the opening of the valve cabinet door;

c) acoustic alarm, initiated when the driver attempts to drive away while the LPG pump is still running or the hose is not fully retracted;

d) interlock that ensures that delivery hoses are disconnected and made secure before the road tanker is driven.

11.2 Emergency Shut-Down system (ESD)

11.2.1 The LPG equipment of the road tanker shall include an ESD system initiated by a minimum of two manual devices located at convenient positions on the road tanker and adequately labelled to indicate their use, or one manual device located on the road tanker combined with either:

— a rip cord (emergency cord) laid down on the ground beside the LPG road tanker during filling and discharge; or

— remote systems.

11.2.2 The ESD system shall immediately initiate the shut-down of the discharge pump and the primary shut-off valve on the pressure vessel.

12 General safety requirements

12.1 Operating devices shall be capable of being operated safely without harm to the operator.

The mode of operation of these devices shall be permanently marked on them if the method of operation is not obvious by virtue of its design.

12.2 Lighting shall be provided on the road tanker to enable the LPG equipment and accessories to be operated safely.

12.3 Means of reaching the elevated devices shall be provided where regular access is necessary.

12.4 Flaps, doors, hoods etc. shall be provided with means of preventing inadvertent movement or activation of related safety systems that may cause injury.

12.5 Demountable equipment e.g. fire extinguishers, shall be secured during transport.

12.6 Rotating machinery shall be guarded where necessary.

12.7 Filling and discharge openings shall be capped or plugged when not in use.

Annex A
(normative)

Discharge rates for pressure relief valves — Discharge capacity

Pressure relief valves shall be sized for full fire engulfment using the formula given below.

The discharge capacity given by the following formula is based on accumulating conditions e.g. 120 % above the start-to-discharge pressure of the safety relief valve.

Pressure relief devices shall be capable of discharging air at a rate of flow *Q* (in cubic metres per seconds) given by the following formula:

$$Q = 12{,}4 \times \frac{A^{0{,}82} \times F}{L \times C} \times \frac{\sqrt{Z \times T}}{\sqrt{M}}$$

where

Q is the required air discharge capacity (m^3/s) at atmospheric pressure and 0 °C;

A is the total external surface area of pressure vessel (m^2);

F is a coefficient with the following value:

$F=1$ for un-insulated pressure vessels and

$F = \frac{8 \times u(649 - t)}{13{,}6}$ for insulated pressure vessels.

where

u is the overall thermal conductance of the insulation determined at 37,8 °C (kJ/m^2 per hour per degree Celsius);

t is the temperature of the pressure vessel contents, in °C. If unknown, a value of *t* = 15 °C shall be used. The value of *F* shall in no case be taken as less than 0,25;

Z is the gas compressibility factor at the accumulating condition. If unknown, a value of *Z* = 1,0 shall be used;

T is the absolute temperature, in *K*, above the pressure relief valve at the accumulating condition;

L is the latent heat of evaporation, kJ/kg, at the accumulating condition;

M is the relative molecular mass of the gas;

C is the constant based on the ratio of specific heat capacities of the gas, $K = C_p/Cv$ (see Table A.1). A value of 0,606 corresponding to a ratio of 1,0 shall be used in the absence of definite data.

Table A.1 — Constant *C* for gas or vapour related to the ratio of specific heat capacities ($K = C_p/Cv$) at standard conditions

K	*C*	*K*	*C*	*K*	*C*
1,00	0,606	1,32	0,671	1,64	0,722
1,02	0,611	1,34	0,674	1,66	0,725
1,04	0,615	1,36	0,677	1,68	0,728
1,06	0,620	1,38	0,681	1,70	0,731
1,08	0,624	1,40	0,685	1,72	0,734
1,10	0,628	1,42	0,688	1,74	0,736
1,12	0,633	1,44	0,691	1,76	0,739
1,14	0,637	1,46	0,695	1,78	0,742
1,16	0,641	1,48	0,698	1,80	0,745
1,18	0,645	1,50	0,701	1,84	0,750
1,20	0,649	1,52	0,704	1,88	0,755
1,22	0,652	1,54	0,707	1,92	0,760
1,24	0,656	1,56	0,710	1,96	0,765
1,26	0,660	1,58	0,713	2,00	0,770
1,28	0,664	1,60	0,716	2,04	0,774
1,30	0,667	1,62	0,719		

Annex B
(informative)

Calculation of mountings of pressure vessel to the chassis

B.1 General

Mountings shall be capable of withstanding, under the maximum admissible load, forces as given in Table B.1 below.

Table B.1 — Forces for fixing the pressure vessel to the road tanker

Direction	Definition	Force *N*
In the direction of travel	F_1 = twice the force applied by the total mass	2 *g* P_3
At right angles to the direction of travel	F_2 = the force applied by the total mass	1 *g* P_3
Vertically upwards	F_3 = the force applied by the total mass	1 *g* P_3
Vertically downwards	Not relevant in this calculation	-
See Figure B.1.		

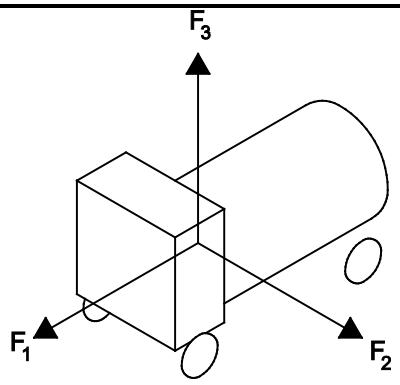


Figure B.1 — Forces for fixing the pressure vessel to the road tanker

Characteristics of the pressure vessel:

Tare mass =	P_1 (kg)	
Maximum load =	P_2 (kg) =	volume in litres × filling ratio in kg/l
Total mass =	P_3 (kg) =	$P_1 + P_2$

B.2 Mounting of pressure vessel to the chassis

B.2.1 Fixing rods

Number of fixing rods: N_1

Mechanical characteristics of steel:

— ultimate tensile strength: R_{m1} (N/mm^2)

— yield strength: R_{e1} (N/mm^2)

— cross sectional area of the rod (internal to thread): S_1 (mm^2)

B.2.2 Bolts

Number of bolts per bracket (see Figure B.4): N_2

Mechanical characteristics of steel:

— ultimate tensile strength: R_{m2} (N/mm^2)

— yield strength: R_{e2} (N/mm^2)

— cross sectional area of the bolts (internal to thread): S_2 (mm^2)

B.2.3 Bracket welds

Area of weld section contributing to bracket strength (see Figure B.3):

$$S_3 = 2 \times (L_1 + 2 \times L_2) \times b \text{ (mm}^2\text{)}$$

Mechanical characteristics of the material of the bracket welds:

— ultimate tensile strength: *R*m3 (N/mm2)

— yield strength: *R*e3 (N/mm2)

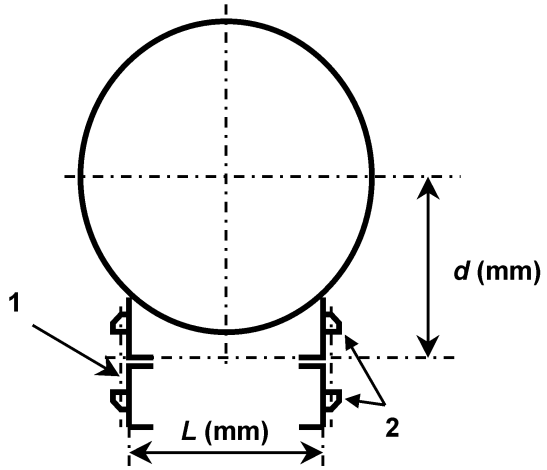
B.2.4 Allowable stress

$$\sigma \leq 0{,}75$$

or

$$0{,}5 \times R_m$$

B.2.5 Typical mounting



Key

d	height of pressure vessel centre line above chassis (mm)
L	outer width of chassis (mm)
1	fixing rods
2	brackets

Figure B.2 — Example of typical mounting of pressure vessel

Moment produced by F_2 (see Figure B.2):

$$M_2 = d \times F_2 \text{ (N/mm}^2\text{)}$$

Reaction to M_2 produced by fixing rod:

$$f_2 = \frac{d \times F_2}{L} \text{ (N)}$$

B.3 Calculation of fixing rods

B.3.1 In the direction of travel

— Tensile stress in the rods:

$$\sigma_1 = \frac{F_1}{S_1 \times N_1} \text{ (N/mm}^2\text{)}$$

— Allowable stress:

$$\sigma_1 \leq \sigma \text{ (N/mm}^2\text{)}$$

where

$$\sigma \leq 0{,}75 \cdot R_{e1}$$

or

$$\sigma \leq 0{,}5 \cdot R_{m1}$$

(whichever is the lower)

B.3.2 At right angles to the direction of travel

— Tensile stress in the rods:

$$\sigma_2 = \frac{f_2}{S_1 \times \frac{N_1}{2}} \text{ (N/mm}^2\text{)}$$

— Allowable stress:

$$\sigma_2 \leq \sigma \text{ (N/mm}^2\text{)}$$

where

$$\sigma \leq 0{,}75 \cdot R_{e1}$$

or

$$\sigma \leq 0{,}5 \cdot R_{m1}$$

(whichever is the lower)

B.3.3 Vertically upwards

— Tensile stress in the rods:

$$\sigma_3 = \frac{F_3}{S_1 \times N_1} \text{ (N/mm}^2\text{)}$$

— Allowable stress:

$$\sigma_3 \leq \sigma \quad \text{(N/mm}^2\text{)}$$

where

$$\sigma \leq 0{,}75 \cdot R_{e1}$$

or

$$\sigma \leq 0{,}5 \cdot R_{m1}$$

(whichever is the lower)

B.4 Calculation of the bracket welds

B.4.1 General

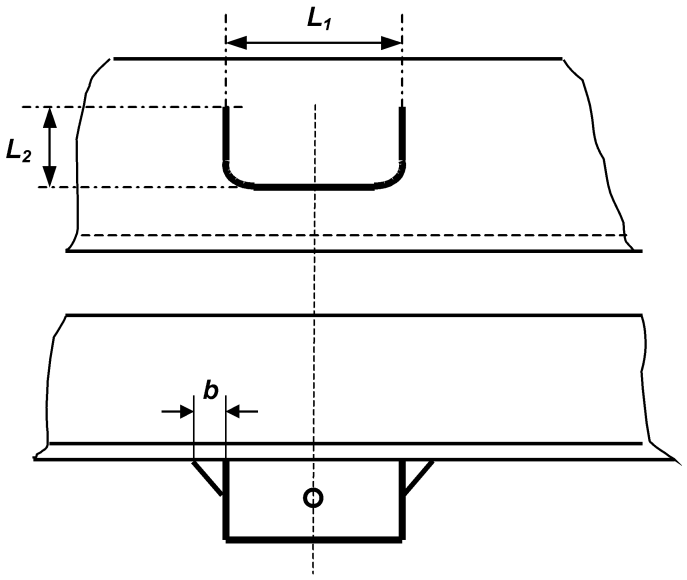


Figure B.3 — Bracket welds

B.4.2 In the direction of travel

Since the number of brackets is equal to the number of fixing rods:

$$\sigma_4 = \frac{F_1}{S_3 \times N_1} \text{ (N/mm}^2\text{)}$$

B.4.3 At right angles to the direction of travel

$$\sigma_5 \frac{f_2}{S_3 \times \frac{N_1}{2}} \text{ (N/mm}^2\text{)}$$

B.4.4 Vertically upwards

$$\sigma_6 = \frac{F_3}{S_3 \times N_1} \text{ (N/mm}^2\text{)}$$

Allowable stress (the lowest of these values shall be considered):

$\sigma_4 \leq \sigma$ (N/mm^2)

$\sigma_5 \leq \sigma$ (N/mm^2)

$\sigma_6 \leq \sigma$ (N/mm^2)

where

$$\sigma \leq 0{,}75 \times R_{e1}$$

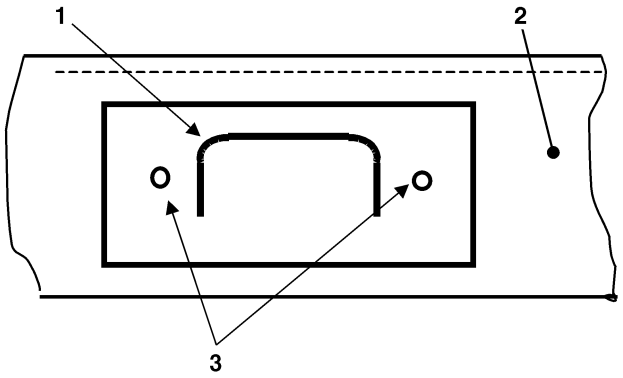
or

$$\sigma \leq 0{,}5 \times R_{m1}$$

(whichever is the lower)

B.5 Calculation of fixing bolts

B.5.1 General



Key

1 brackets
2 chassis frame
3 bolts

Figure B.4 — Fixing bolts

B.5.2 In the direction of travel

$$f_7 = \frac{F_1}{N_1} \text{ (N)}$$

$$\sigma_7 = \frac{f_1}{S_2 \times N_2} \text{ (N/mm}^2\text{)}$$

B.5.3 At right angles to the direction of travel

$$F_8 = \frac{f_2}{\left(\frac{N_1}{2}\right)} \text{ (N)}$$

$$\sigma_8 = \frac{f_8}{S_2 \times N_2} \text{ (N/mm}^2\text{)}$$

B.5.4 Vertically upwards

$$f_9 = \frac{f_3}{N_1} \text{ (N)}$$

$$\sigma_9 = \frac{f_9}{S_2 \times N_2} \text{ (N/mm}^2\text{)}$$

Allowable stress (the lowest of these values shall be considered):

$\sigma_7 \leq \sigma$ (N/mm^2)

$\sigma_8 \leq \sigma$ (N/mm^2)

$\sigma_9 \leq \sigma$ (N/mm^2)

where

$\sigma \leq 0{,}75 \times R_{e1}$

or

$\sigma \leq 0{,}5 \times R_{m1}$

(whichever is the lower)

Annex C
(informative)

Environmental Checklist

Environmental Aspect	Stages of the life cycle										All stages
	Acquisition		Production		Use			End-of-Life			
	Raw materials and energy	Pre-manufactured materials and components	Production	Packaging	Use	Maintenance and repair	Use of additional products	Reuse / Material and Energy Recovery	Incineration without energy recovery	Deposition	Transportation
Inputs											
Materials		4.1	9.2.1								
Water			10.2					10.2.4		10.2 .3	
Energy		4.1	9.2.1								
Land											
Outputs											
Emissions to air											
Discharges to water										10.2 .3	
Discharges to soil										10.2 .3	
Waste											
Noise, vibration, radiation, heat losses											
Other relevant aspects											
Risk to the environment from accidents or unintended use		4.1 11.2	6.1.3								
Customer information											

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