BS EN 15609:2012

BSI Standards Publication

LPG equipment and accessories — LPG propulsion systems for boats, yachts and other craft

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National foreword

This British Standard is the UK implementation of EN 15609:2012. It supersedes BS EN 15609:2008 which is withdrawn.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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Flüssiggas-Geräte und Ausrüstungsteile - Flüssiggas-(LPG-) Antriebsanlagen für Boote, Jachten und andere Wasserfahrzeuge

This European Standard was approved by CEN on 16 March 2012.

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Foreword

This document (EN 15609:2012) has been prepared by Technical Committee CEN/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of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

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 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).

For relationship with EU Directive(s), see informative Annex ZA which is an integral part of this document.

This document supersedes EN 15609:2008.

The main changes with respect to the previous edition include:

— the addition of Annexes E, G and H;

— expansion of requirements of the installer;

— removal of the specific requirements for the EN 13760 nozzle;

— components fitted to the cylinder;

— tightness test pressure increased to 10 bar;

— optional forced ventilation for the locker, 5.5.4; and

— gas detection requirements.

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, 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 specifies requirements for the installation of equipment for the use of Liquefied Petroleum Gas (hereafter referred to as LPG) in the propulsion systems of small craft.

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: it does not absolve the user from their legal obligations relating to health and safety at any stage.

Protection of the environment is a key political issue in Europe and elsewhere. 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) during all phases of its existence, from use, to scrapping, to recycling of materials, etc.

Annex I comprises an environmental checklist which highlights the clauses of this European Standard that address environmental aspects.

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

This European Standard is based on EN 12979 [3].

1 Scope

This European Standard specifies the requirements for LPG propulsion systems on craft with hull lengths less than or equal to 24 m, including those defined by Directive 94/25/EC.

This European Standard does not cover appliances with directly attached gas cylinders, such as portable self-contained camping stoves and portable gas lamps.

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 1442, *LPG equipment and accessories — Transportable refillable welded steel cylinders for LPG — Design and construction*

EN 12805, *Automotive LPG components — Containers*

EN 12806:2003, *Automotive liquefied petroleum gas components — Other than containers*

EN 12864, *Low-pressure, non adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures*

EN 13110, *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 14291, *Foam producing solutions for leak detection on gas installations*

EN 14427, *Transportable refillable fully wrapped composite cylinders for Liquefied Petroleum Gases (LPG) — Design and Construction*

EN 28846, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases (ISO 8846)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

EN ISO 898-1:2009, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2009)*

EN ISO 9094-1, *Small craft — Fire protection — Part 1: Craft with a hull length of up to and including 15 m (ISO 9094-1)*

EN ISO 9094-2, *Small craft — Fire protection — Part 2: Craft with a hull length of over 15 m (ISO 9094-2)*

EN ISO 10133, *Small craft — Electrical systems — Extra-low-voltage d.c. installations (ISO 10133)*

EN ISO 10239, *Small craft — Liquefied petroleum gas (LPG) systems (ISO 10239)*

EN ISO 10240, *Small craft — Owner's manual (ISO 10240)*

EN ISO 11105, *Small craft — Ventilation of petrol engine and/or petrol tank compartments (ISO 11105)*

EN ISO 11591, *Small craft, engine-driven — Field of vision from helm position (ISO 11591)*

EN ISO 12217 (all parts), *Small craft — Stability and buoyancy assessment and categorization*

EN ISO 13297, *Small craft — Electrical systems — Alternating current installations (ISO 13297)*

ISO 630, *Structural steels — Plates, wide flats, bars, sections and profiles*

ISO 20826, *Automotive LPG components — Containers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12806:2003 and the following apply.

3.1
liquefied petroleum gas
LPG
one or more light hydrocarbons which are assigned to either UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only, and which consist mainly of propane, propene, butane, butane isomers and butene with traces of other hydrocarbon gases

Note 1 to entry: For automotive LPG specification, see EN 589 [1].

3.2
LPG system
installation consisting of an arrangement of container(s), safety device(s), pressure regulator(s), vaporiser(s), connection(s), valve(s), piping, tubing, hose, fitting(s) and devices intended to store, supply, monitor or control the flow of LPG up to and including the appliance and engine

Note 1 to entry: The cylinders are replaceable items and might not be supplied with the LPG system in the craft.

3.3
competent person
person who, due to a combination of appropriate qualifications, training, experience and resources, is able to make objective judgments on the subject

3.4
container
vessel used for the storage of LPG

3.5
cylinder
transportable, refillable container with a water capacity from 0,5 l up to and including 150 l

3.6
fixed container
LPG pressure vessel permanently installed to the structure of the craft

3.7
contents gauge
device to indicate the liquid level or contents in a pressure vessel

3.8
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

3.9
overfill protection device
OPD
device designed to automatically reduce the filling rate to a minimal flow when the fill level reaches a predetermined amount

Note 1 to entry: In marine applications the predetermined amount is 80 % of the water capacity.

3.10
filler valve
valve system for liquid fill service

3.11
pressure relief device
component protecting the pressure vessel from bursting by venting the LPG content at a pre-set temperature

3.12
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

3.13
non-return valve
valve designed to close automatically to restrict reverse flow

3.14
fuel system
installation required to supply LPG to the engine

3.15
vaporiser
device intended to vaporise LPG from a liquid to a gaseous state

3.16
hydrostatic relief 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

3.17
pressure regulator/vaporiser
single device incorporating both a pressure regulator and vaporiser

3.18
ventilation system
assembly of ducts and an electrical ventilator that is capable of extracting hydrocarbons from the inside of the craft and allowing the entrance of fresh air

3.19
container housing
ventilated enclosure intended solely for storage of one or more LPG containers, pressure regulators and safety devices, and located on the exterior of the boat where any leakage would flow overboard

3.20
container locker
gas-tight (to the craft) enclosure with an overboard drain, where any leakage would flow overboard, intended solely for storage of one or more LPG containers in a cockpit or recess in the craft

3.21
permanently installed
securely fastened so that tools have to be used for removal

3.22
accessible
capable of being reached for inspection, removal or maintenance without the removal of permanent craft structures

Note 1 to entry: Hatches are not regarded as permanent craft structures in this sense, even if tools such as wrenches or screwdrivers are needed to open them.

3.23
readily accessible
capable of being reached for operation, inspection or maintenance without the removal of any craft structure, the use of any tools or the removal of any item of portable equipment stowed in places intended for storage of portable equipment such as lockers, drawers or shelves

Note 1 to entry: Hatches are not regarded as permanent craft structures in this sense.

3.24
installer
person or organisation who, due to qualifications, training, experience and resources, can assume technical responsibility for the installation of the LPG propulsion system

3.25
appliance
appliance that is designed for heating, cooking, lighting, refrigeration, hot water production or electricity production (fuel cell or generator), using LPG as its energy source

3.26
cockpit
area within the craft that can retain water, however briefly, due to rain, waves, boat heeling, etc.

Note 1 to entry: Cockpits are normally designed for the accommodation of people but, for the purpose of this European Standard, the term "cockpit" is used either for a proper cockpit or for any other type of recess. This means that bulwarks can create a large cockpit, open boats can effectively comprise a cockpit (which includes nearly all the boat), cockpit(s) can be situated anywhere in the boat and a cockpit can open aft to the sea.

3.27
venting tube
duct that connects the gas-tight housing to the atmosphere

3.28
shut-off valve
valve that provides a leak-tight seal which is operated either manually, remotely or is self-closing

3.29
gas detection
revealing of the presence of LPG due to exposure outside the LPG containment system

3.30
dual-fuel
engine designed to operate two separate fuel systems and to run either on LPG or an alternative fuel

3.31
inspection body
independent inspection and testing body approved by the competent authority

3.32
pressure vessel
assembly of the pressure-retaining envelope (including the openings and their closures) and non-pressure-retaining parts attached directly to it

4 Components

4.1 General provisions

The LPG system shall be designed by a competent person.

Individual components of the system, and the system as a whole, shall be designed to withstand the combined conditions of pressure, vibration, shocks, corrosion and movement encountered under normal operation.

All materials used in LPG systems shall be compatible with LPG and with other liquids or compounds with which it might come into contact under normal operating conditions, e.g. grease, lubricating oil, bilge solvents, fresh water and sea water.

Efforts should be made to prevent grease, lubricating oil, bilge solvents and other chemicals from contaminating the marine environment.

4.2 LPG containers

4.2.1 General provisions

The LPG container(s) shall be protected from corrosion in the marine environment by an adequate surface treatment system, or be constructed from materials suited to the marine environment.

For the purpose of this standard, two types of LPG containers are identified:

— cylinders; and

— fixed containers.

4.2.2 Cylinders

4.2.2.1 LPG cylinders can be used in the liquid or gas/vapour phase to fuel the engine of a craft depending on the choice of technology and the required power.

4.2.2.2 The cylinders used on craft shall comply with one of the following:

a) EN 1442;

b) EN 13110;

c) EN 14140;

d) EN 14427; or

e) an equivalent standard.

4.2.2.3 The quantity of LPG fuel on board shall be indicated by the use of cylinders fitted with contents gauges or by the provision to carry additional reserve cylinder(s).

4.2.2.4 A PRV shall be fitted to any cylinder greater than 17 l water capacity.

4.2.3 Fixed container

4.2.3.1 General

Fixed containers shall comply with EN 12805, ISO 20826 or an equivalent standard.

4.2.3.2 Components fitted to the fixed container

4.2.3.2.1 The container shall be equipped with the following components, which can be either separate or combined (e.g. multivalve):

a) overfill protection device,

b) filler valve,

c) contents gauge,

d) pressure relief valve or pressure relief device and

e) remotely controlled service valve with excess flow valve.

4.2.3.2.2 The container can be equipped with a:

a) gas-tight housing;

b) power supply bushing for actuators/LPG fuel pump;

c) LPG fuel pump inside the container; and

d) non-return valve.

4.2.3.2.3 All components fitted to the container shall comply with EN 12806.

4.2.3.2.4 The filler valve shall incorporate a double non-return valve which shall comply with Annex G of EN 12806:2003.

4.3 Fuel system components

4.3.1 Vaporiser

4.3.1.1 Vaporisers shall comply with EN 12806 and shall be suitable for use in the marine environment.

4.3.1.2 The materials of the vaporiser, which are in contact with the engine coolant, shall be compatible with the coolant and shall be designed to withstand a pressure of 2 bar of the heat exchange medium.

4.3.1.3 A suitable test procedure for metallic vaporisers is given in Annex E.

4.3.2 Other components

The following components of the fuel system, where used, shall comply with EN 12806 and shall be suitable for use in the marine environment:

a) shut-off valve;

b) gas injection device or injector;

c) gas mixing unit;

d) gas dosage unit;

e) flexible fuel hoses and gas pipes;

f) hydrostatic relief valve;

g) LPG filter unit;

h) pressure and/or temperature sensor;

i) service coupling;

j) electronic control unit;

k) fuel rail;

l) filler unit;

m) fuel pump.

Additional equipment required for the effective operation of the engine, not covered by EN 12806, shall only be installed in parts of the LPG system where the pressure is less than 0,2 bar.

5 Installation requirements

5.1 General requirements

5.1.1 The LPG system shall be installed by a competent person, taking into account the manufacturer's instructions and sound engineering practices in addition to each of the requirements in 5.1.

5.1.2 All parts of the LPG system, with the exception of the cylinder(s), shall be permanently installed.

5.1.3 All parts of the LPG system shall be securely fastened.

5.1.4 The completed LPG system shall be adequately protected against corrosion.

5.1.5 All valves and other components intended to be manually operated or observed during the normal operation of the craft, or for emergency purposes, shall be readily accessible.

5.1.6 All other components of the LPG system shall be accessible.

5.1.7 No component of the fuel system shall be located within 100 mm of the exhaust or similar heat source, unless adequate shielding against heat is provided.

5.1.8 Clearance between dry exhaust components and an LPG container shall not be less than 250 mm, unless an equivalent thermal barrier is provided.

5.1.9 Fuel containers and components of fuel systems shall not be installed directly above batteries, unless the batteries are protected against the effects of fuel leakage.

5.1.10 The fuel system shall function in such a manner that the pressure for which it has been designed and approved cannot be exceeded.

5.1.11 The fuel system shall be adequately protected against damage.

5.1.12 No component of the LPG system shall obstruct the field of vision from the helm position in accordance with the requirements of EN ISO 11591.

5.1.13 Permanent and clearly visible labels indicating LPG shall be fixed on one or more of the following locations:

— on or close to the engine(s);

— on or adjacent to the container housing(s);

— on or close to container lockers(s); and

— on the exterior of the craft.

NOTE An example of a suitable label is given in Annex H.

5.2 Installer of the LPG system

5.2.1 The installer shall possess the competence and expertise necessary for the proper installation of the LPG system and have a quality control system that ensures that the installation of the system meets the requirements of this Standard.

5.2.2 The installer shall install components in accordance with the manufacturer's instructions or other limitations.

5.2.3 The installer shall endeavour to minimise the wastage of materials used and shall dispose of surplus materials in an environmentally friendly manner.

NOTE Material segregation bins should be used for recycling materials.

5.2.4 The installer shall maintain records of the commissioning tests as detailed in Clause 8.

5.2.5 The installer shall issue a signed installation certificate incorporating a certificate of conformity to this standard upon satisfactory completion of the LPG system installation and commissioning.

NOTE An example of an installation certificate is given in Annex G.

5.2.6 The installer shall supply an owner's manual for the LPG system as outlined in Clause 7.

5.3 Additional LPG systems

5.3.1 The installation of other LPG systems (e.g. for cooking and heating appliances) shall comply with EN ISO 10239.

5.3.2 These types of installation shall be connected to the vapour phase of the fuel container.

5.3.3 The vapour takeoff system shall be protected by a manual or remotely controlled shut-off valve incorporating an excess flow device fitted to the container.

5.3.4 The operation of the propulsion system shall not be affected by the introduction of additional LPG systems.

5.4 Modifications to the structure of the craft

5.4.1 Any alteration or modification to any craft resulting from the installation of LPG equipment shall be carried out in accordance with sound engineering practices and in compliance with the relevant marine standards.

5.4.2 The installation of LPG containers shall not adversely affect the stability and buoyancy of the craft when evaluated in accordance with EN ISO 12217 (all parts).

5.4.3 Where any substantial modification is made to the craft structure to facilitate the installation of the fuel system, a written agreement accompanied by a detailed drawing shall be obtained from the builder of the craft or from a notified body.

5.5 Container installation

5.5.1 General

5.5.1.1 The container shall:

— be stowed either in the open air or in a container locker;

— not be stowed in the engine compartment, unless in a container locker (see 5.5.4);

— not be stowed in accommodation spaces;

— be securely fastened to the craft;

— be installed in the correct orientation according to the container manufacturer instructions;

— be installed in such a manner that it does not form an obstruction;

— be installed in such a way that provisions for escape in the event of fire and/or inversion are not negatively affected; and

— allow drainage from their surfaces when the craft is in its static flotation position.

5.5.1.2 When stored in open air, LPG containers, pressure regulators and safety devices shall be shielded from direct solar radiation, and shall have the vents protected against the ingress of dirt and water by positioning or shielding.

5.5.1.3 Containers, pressure regulators and safety devices located below decks or in cockpits shall be mounted in container lockers.

5.5.1.4 No provision shall be made in a container locker or container housing for the storage of loose components that could damage the container, pressure regulator, piping or hose installation or obstruct the locker drain.

5.5.1.5 Containers shall be installed and fixed so that a 3 g acceleration can be absorbed without any damage in any direction of movement while the container is fully loaded.

5.5.1.6 Containers shall not be directly in contact with the floor and shall be spaced a minimum of 20 mm from the floor.

5.5.1.7 The container shall be installed so that there is no metal-to-metal contact, other than at any of the permanent fixing points.

5.5.2 Fixed containers

5.5.2.1 Containers shall be permanently installed in such a manner that they do not support decks, bulkheads or other craft structures, unless they are designed for that purpose.

5.5.2.2 Containers shall not be integral with the hull.

5.5.2.3 Containers shall be installed in a manner that allows inspection and maintenance of fittings, hose connections, etc.

NOTE Hatches for inspection or maintenance of fuel tanks and LPG containers can be covered by uncut carpet, provided that all tank and container fittings can be inspected and maintained through other openings.

5.5.2.4 Where the container is secured to the craft by a container frame and/or container straps, the container shall be installed according to the requirements of Annex A or Annex B as appropriate.

5.5.2.5 Supports, chocks or hangers shall be separated from the surface of metal containers by a non-metallic, non-hygroscopic, non-abrasive material unless welded to the container.

5.5.2.6 Foam shall not be the sole means used to secure containers in place. Where foam is in contact with the container, due care shall be taken to avoid corrosion.

5.5.2.7 Metallic containers within the hull shall be installed with the container bottom no less than 25 mm above the normal maximum bilge water level.

5.5.3 Cylinders

5.5.3.1 Cylinders shall be securely fastened by a dedicated system to the structure of the craft. This requirement also applies to unconnected cylinders.

Where the cylinders are permanently fixed to the craft by container straps, the cylinder shall be fixed in accordance with the requirements of Annex C.

5.5.3.2 Cylinders shall be installed so that they are readily accessible.

5.5.3.3 Cylinders designed to be used on their sides (e.g. forklift truck type) shall be secured at the correct rotational angle (to ensure correct liquid off-take and pressure relief valve position).

5.5.3.4 For cylinders working on a vapour/gas phase, the pressure regulator shall be in accordance with EN 12864 and installed directly after the cylinder's valve outlet.

5.5.4 Container lockers

5.5.4.1 Container lockers openable from inside the cockpit shall be opened only from the top.

5.5.4.2 Lockers, when closed, shall be gas-tight to the craft interior and vented at the bottom by a drain of not less than DN/ID 19 (or the equivalent area if not circular) for containers having a combined capacity of up to 15 kg.

5.5.4.3 The internal diameter of the drain shall be enlarged *pro rata* where additional containers are carried.

5.5.4.4 The locker drain shall be run overboard, i.e. to the outside of the craft; and shall not be fitted with sumps which can retain water. It shall either:

a) have an outlet at a level lower than the locker bottom and as high as is practicable, but not less than 75 mm above the at-rest waterline in the fully loaded ready-for-use condition; or

b) be fitted with forced ventilation meeting the following requirements:

1) a gas sensor shall be fitted in the locker at the lowest level where gas could accumulate;

2) the ventilation system shall be explosion proof;

3) the ventilation fan shall be flameproof and run for a minimum of 60 seconds before the engine can be started; and

4) at least one outlet duct situated at the base shall be fitted to the locker.

5.5.4.5 The outlet duct shall be:

— remote (at least 250 mm) from the engine exhaust system;

— protected from blockage by virtue of its position or other means; and

— located at least 500 mm from any hull opening to the interior of the craft.

5.5.4.6 All hoses or metal piping penetrating the locker walls shall be sealed at the wall so as to maintain gas tightness in the craft interior.

5.5.5 Installation of more than one container

5.5.5.1 Where more than one container is connected to the engine fuel line, the containers shall be installed so that no hydrostatic pressure build-up can take place in the fuel line and that LPG cannot flow from one container into another.

This can be achieved by installing a non-return valve downstream of the remote-controlled service valve or manually operated valve on each container and a hydrostatic relief valve in the delivery tube, downstream of the non-return valves. An adequate filter system shall be placed upstream of the non-return valves to prevent the fouling of the non-return valves (see Figure F.1).

5.5.5.2 A non-return valve and a hydrostatic relief valve are not required where the back-flow pressure of the remote-controlled service valve or the manually operated valve in the closed position exceed 5 bar (see Figure F.2). In this case, the power supply to the remote-controlled service valves shall be wired so that no more than one remote-controlled service valve on the container can be open at any one time. The overlap time to allow switching from one container to another shall be less than 2 min.

5.5.5.3 Each container shall be provided with its own overfill protection device.

5.6 Components fitted to the fixed container

5.6.1 General requirements

The components on and in the container shall be installed under the responsibility of the holder of the bonfire test certificate as described in EN 12805 or ISO 20826.

5.6.2 Remote-controlled service valve with excess flow valve on the container

5.6.2.1 The remote-controlled service valve with excess flow valve shall be installed directly on the container without any intervening fittings.

5.6.2.2 The remote-controlled service valve with excess flow valve shall be controlled so that it automatically closes when the engine stops or when the ignition is turned off.

5.6.3 Pressure relief valve

The pressure relief valve shall be installed in or on the container without intermediate fittings so that it is connected to the vapour space and shall discharge to the atmosphere directly or via a gas-tight housing, if fitted.

5.6.4 Filler valve

The filler valve shall be installed on the container.

NOTE The filler valve can be combined with the overfill protection device.

5.6.5 Overfill protection device

The overfill protection device shall be specific to the type of container and shall be installed in the correct position using the torque specified by the manufacturer.

NOTE See 5.8.3 for additional requirements where the overfill protection device is combined with the filling unit.

5.6.6 Level indicator

The level indicator shall be suitable for the container and shall be installed in the correct position to ensure its proper operation.

Where an instrument panel is fitted, a level indicator readout should be installed on the panel.

5.6.7 Fittings

The fittings shall be protected from ingresses of dirt and water.

5.6.8 Pressure relief device

The pressure relief device shall be fitted in or on the container so that it discharges overboard directly or via the venting tube, where fitted.

5.7 Gas pipes, tubes and hoses

5.7.1 Gas piping and hoses shall be installed as high as practicable above the bilge water level and shall not be in direct contact to seawater.

5.7.2 Gas piping shall be routed at least 30 mm away from electrical conductors; unless the piping passes through a conduit with no joints, or the conductors are sheathed or in a conduit or trunking in accordance with EN ISO 10133 and EN ISO 13297.

5.7.3 Gas piping shall be supported by fixing devices or other means, such as inside vented, non-metallic, supported conduit or piping, to prevent chafing or vibration damage.

5.7.4 Gas piping and hoses shall be secured so that they are not subject to excessive stress.

EXAMPLE Stresses caused by thermal expansion of the hull and associated components or engine induced vibration.

5.7.5 Gas piping and hoses shall not be in direct contact with metallic parts of the craft structure.

5.7.6 Gas piping and flexible hoses shall be fitted with a protective sleeve at the fixing points in order to prevent abrasion.

5.7.7 Gas piping and flexible hoses shall be secured by clamps to the main structure of the craft or to parts rigidly connected to the main structure of the craft.

5.7.8 The fixing devices shall be corrosion-resistant, non-abrasive, and designed to prevent cutting or other damage to the piping and compatible with the pipe material.

5.7.9 Fixing devices shall be pipe rings spaced at intervals not exceeding 0,5 m for copper or stainless steel piping and, not more than 1 m for piping of other materials.

5.7.10 Gas piping and hoses passing through bulkheads intended to maintain watertight integrity in the craft at the level of penetration shall be sealed by suitable materials or fittings at the point of penetration.

5.7.11 Gas piping and hoses shall be protected from abrasion or chafing at the point where they pass through walls or bulkheads. A grommet shall be fitted to the hole where piping or flexible hoses pass through the structure of the craft. The outside diameter of the hole through the structure shall be at least 1,5 times the diameter of the pipe or hose that passes through it.

5.7.12 Only seamless copper piping, copper nickel piping or drawn stainless steel piping, which are galvanically compatible, shall be used for rigid fuel supply lines. The minimum wall thickness for piping up to DN/OD 12 shall be 0,8 mm and 1,5 mm for piping greater than DN/OD 12.

5.7.13 Seamless copper gas pipes shall be protected by a rubber or plastic sleeve or coating.

NOTE A flexible hose complying with the requirements of EN 12806 is a preferable alternative to copper gas piping.

5.7.14 Rigid pipe shall not be used between parts which can move in relation to each other. Flexible hose complying with the requirements of EN 12806 shall be used.

EXAMPLE Pipe between the hull and a flexibly mounted engine.

5.7.15 Metallic piping routed through engine compartments shall be protected by conduit or trunking or be supported by non-abrasive attachments no more than 500 mm apart.

5.7.16 Metallic piping shall be at least 100 mm from exposed terminals of electrical devices or accessories.

5.8 Other components

5.8.1 Gas connections between components of the LPG-system

5.8.1.1 Brazed and welded joints are only permitted when the appropriate fittings are used.

5.8.1.2 Welded or brazed joints are permitted, provided that such joints are limited to the factory-assembly of components.

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

5.8.1.3 The melting point of materials at welded or brazed connections shall be not less than 450 °C.

5.8.1.4 The design pressure of the couplings shall be the same or higher than that specified for the gas pipe.

5.8.1.5 Distributing blocks shall be made of corrosion-resistant material.

5.8.1.6 Fittings for connections and joints in piping shall be metallic and of any of the following types:

— brazed connections;

— cutting-ring fittings;

— compression fittings made of copper alloy with solid or thick-walled copper rings on copper piping; or

— stainless steel rings on stainless steel piping.

5.8.1.7 The wall thickness of the ring shall be greater than or equal to 0,5 mm; and a jointing compound shall not be used on compression or flared fittings.

5.8.1.8 Fittings shall be galvanically compatible with the metallic piping to which they are connected. Gas pipes shall be connected by appropriate fittings compatible with the material of the pipe.

5.8.1.9 End-connection fittings shall be made of corrosion-resistant material such as brass or stainless steel. Where cutting-ring fittings are used in conjunction with copper piping, a brass insertion sleeve and brass cutting ring shall be fitted. All components shall be matched, i.e. shall be of the same series.

5.8.1.10 The number of joints and fittings shall be kept to a minimum. All joints and fittings shall be readily accessible for inspection.

5.8.1.11 All joints and connections in piping and hose in the systems shall be made so that no undue stress is created at the fitting.

5.8.1.12 Except for bulkhead fittings, there shall be no joints or fittings in piping which passes through engine compartments.

5.8.1.13 Connections shall only be made in ventilated compartments with the exception of the engine space.

5.8.1.14 In the accommodation or other enclosed compartments, the gas pipe or flexible hose shall not be longer than required for safe installation.

5.8.1.15 If the LPG-system requires a return pipe or hose to the container, the connection on the container shall be provided with a non-return valve.

5.8.1.16 Hose clamps, if used to secure cylinder-locker vent hoses, shall be made of corrosion-resistant material, such as stainless steel of type 18Cr8Ni, or an equivalent, and be reusable.

5.8.1.17 Hoses carrying LPG under pressure shall be provided with re-usable mechanical connections.

5.8.1.18 Hose connections shall be stress free, i.e. not subjected to tension or kinking under any conditions of use.

5.8.1.19 Regulators and safety devices shall be secured against any movement that is expected to result from marine service.

5.8.2 Remote-controlled shut-off valve

5.8.2.1 Fixed container − liquid phase

A remote-controlled shut-off valve shall be installed in the piping between the container and the pressure regulator/vaporiser, as close as possible to the pressure regulator/vaporiser. The shut-off valve shall be of the normal closed type.

Where a fuel return system between the pressure regulator and the container is provided, the remote-controlled shut-off valve shall be installed at a location in the engine compartment specified by the manufacturer of the LPG-system.

NOTE The remote-controlled shut-off valve can be combined with the pressure regulator/vaporiser.

The remote-controlled shut-off valve shall be operated in such a way that the fuel supply is cut off when:

— the ignition is switched off, or

— the engine stops; or

— in the case of dual-fuel craft, the alternative fuel is selected.

5.8.2.2 Cylinders — liquid phase

For cylinders equipped with internal piping in the liquid phase (e.g. fork lift truck cylinders), a remote-controlled shut-off valve shall be installed in accordance with 5.8.2.1.

5.8.3 Filling unit

5.8.3.1 The maximum external LPG leak rate of the filling unit during the filling operation shall be 15 cm^3/h.

5.8.3.2 The maximum LPG blow-off volume at disconnection shall be less than 1 cm^3.

5.8.3.3 The filling unit shall be secured against rotation and shall be protected against dirt and water.

5.8.3.4 The filling unit shall be clearly marked to indicate LPG.

5.8.3.5 The filling unit shall be on the outside of the craft and shall not be mounted directly on the container.

5.8.3.6 The filling unit shall not be positioned within 400 mm horizontal radius, or vertically above any ventilation opening.

5.9 Electrical installation

5.9.1 Fuel system electrical components shall be installed in accordance with EN ISO 10133.

5.9.2 There shall be no potential sources of ignition in LPG cylinder lockers, housings or compartments.

5.9.3 Electrical devices shall be ignition-protected in accordance with EN 28846 when located in:

— container lockers, container housings; or

— compartments containing valves, fittings or connections of the LPG system; or

— compartments containing unattended appliances of the LPG system.

5.9.4 The following are exempt from the requirements of 5.9.3:

— accommodation spaces;

— compartments open to the atmosphere outside the craft and having an open area of at least 0,34 m^2/m^3 of compartment volume.

NOTE Spaces below cabin floors or soles are not considered part of the accommodation space unless there are permanent openings (for example, if they are not separated by close fitting doors or panels).

5.9.5 The electrical components of the LPG-system shall be protected against overloads, and at least one dedicated fuse or circuit breaker shall be provided.

The fuse/circuit breaker shall be installed in a known location and shall be readily accessible.

5.9.6 Fuses or circuit breakers shall not be installed inside the gas-tight housing.

5.9.7 The electrical power to components which carry LPG, shall not be conducted by a gas pipe. Gas pipes shall not be used for earthing.

5.9.8 Electrical cables shall be adequately protected against damage.

5.9.9 The electrical connections inside the engine compartment or other enclosed compartments shall comply with degree of protection class IP 40 according to EN 60529. All other electrical connections shall comply with insulation class IP 54 according to EN 60529.

5.9.10 Electrical connections and components in the gas-tight housing shall be constructed so that no sparks are generated.

5.9.11 Electrical connections, with the exception of the earth connection, shall be electrically insulated.

5.9.12 Bare metal conductors are not permitted.

5.10 Fuel selection system

Dual-fuel crafts shall have a fuel selection system to ensure that only one fuel is supplied to the engine at any one time.

An overlap time of a maximum of two seconds for switching over fuels is allowed.

This does not apply to craft that have engines that operate on both fuels at the same time.

5.11 Gas detection

5.11.1 General

Where the engine and/or the LPG storage are below deck and there is a possibility of gas accumulation, a gas detection system shall be installed.

The gas detection system shall be permanently fixed to the craft and shall comply with all the following requirements:

a) be suitable for the marine environment, resistant to corrosion and the entry of dust;

b) be capable of continuous operation from a low voltage source (e.g. wired direct to a battery via fuses) and indicate the operational status within 30 s after power being supplied;

c) have at least two electrical outlets for the connection of external equipment (e.g. audible alarms, bilge blowers, etc.);

d) have a latching system that continues to indicate an alarm condition until cancelled;

e) be self-checking and indicate both normal and fault conditions;

f) have fully serviceable units and be supplied with full installation and operating instructions;

g) have switches that indicate their operational position (permanently marked); and

h) have all markings visible on the unit, including the manufacturer's name and address (permanently marked).

When gas is detected at 20 % of the Lower Explosive Limit (LEL), an audible and visual warning alarm shall begin and the ventilation system described in 5.12 shall start. The visual alarm shall not be overridden other than by turning off the electrical supply of the fuel system.

5.11.2 Alarm position

The alarm on the gas detection system shall be positioned to ensure that it is audible and visible from the helm position or wheelhouse under normal operating conditions.

5.11.3 Sensors position

A minimum of two sensors shall be fitted: one in the engine compartment of inboard engined craft and one in the bilge at the lowest level where gas could accumulate but above the high-bilge-water level. Where the engine compartment is also the lowest point above the high-bilge-water level, only one sensor is required.

Consideration should be given to the positioning of additional sensors in the gas container compartments and accommodation spaces.

5.12 Forced ventilation

5.12.1 General

Engine compartments shall have forced ventilation in accordance with EN ISO 11105 and the requirements of 5.12. This ventilation system shall be ignition-protected in accordance with EN 28846.

5.12.2 Purging of engine space

The ventilation fan shall run for a minimum of 60 s before the engine can be started.

5.12.3 Position of venting

At least one inlet duct shall extend down to the lower one-third of the engine compartment and above the normal level of accumulated bilge water to clear fumes from the bilge and promote the circulation of fresh air.

6 Fire-extinguishing equipment

Fire-extinguishing equipment shall be installed and meet the requirements for petrol engines in accordance with EN ISO 9094-1 or EN ISO 9094-2.

NOTE Portable fire extinguishers should comply with EN 3-7.

7 Owner's manual

7.1 The craft manufacturer shall provide an owner’s manual, which is in accordance with EN ISO 10240, in the language of the country of use. It shall include the user instructions supplied by the manufacturers of the equipment and appliances.

7.2 In the case of retrofits, the installer shall provide an owner’s manual, in the language of the country of use, for the specific use of the craft running on LPG.

7.3 Requirements and guidance for the contents of the owner’s manual shall be in accordance with Annex D.

8 Commissioning

8.1 Tightness test

8.1.1 Except for the case approved under 8.1.2, any system, including the container(s) and all joints, shall be submitted to an inert gas tightness test at a test pressure of a least 10 bar but at a maximum of 90 % of the container's design pressure for a minimum of 10 min. A proprietary leak detection fluid, complying with EN 14291 or any other method of equivalent sensitivity, shall be used.

8.1.2 If the container(s) and the components are tested independently from the rest of the system and are filled with LPG, the rest of the system shall be tested separately in compliance with 8.1.1 before connecting it to the fuel container(s) and terminal joint(s). It shall then be submitted to a tightness test under the fuel container's available pressure.

8.1.3 To pass the test, there shall be no leaks.

NOTE LPG cylinders are not required to be tightness tested.

8.2 Initial filling of the container and the system with LPG

The fuel container(s) can only be filled with LPG for the first time when the tightness testing as per 8.1 has been completed and there is confirmation that all leaks have been eliminated.

8.3 Fuel system test

After the initial filling with LPG, a final tightness test shall be performed on all joints which have not yet been tested under LPG pressure (see 8.1).

The control system should be tested at this stage.

8.4 Water trial

Following the engine's conversion, the craft shall undergo a water test to verify that the performance under normal working conditions is satisfactory.

For dual-fuelled engines working with LPG and gasoline, fuel switching shall be carried out in order to verify that the transition takes place satisfactorily.

Where the LPG fuel system is included in the type approval of the craft, the water trial may be not mandatory for each individual craft produced.

Annex A
(normative)

Fixing requirements for containers with a capacity up to and including 150 l

A.1 General requirements

The container shall be secured to the craft by at least two straps made from steel with a minimum tensile strength of grade E 235 B according to ISO 630. At least two bolts with washers shall be fitted per strap and the fixing bolts shall be of Class 8.8 according to EN ISO 898-1:2009. The required dimensions are specified in Table A.1.

NOTE 1 Where the material into which the fixing bolts are attached is not capable of supporting a threaded connection, a self-threading insert may be used (see Figure A.1).

Table A.1 — Dimensions of bolts, container straps and self-threading insert (see Figure A.1)

Container content (litre)	**Minimum dimensions of the washers** **diameter (a) × thickness (b)** (mm)	**Minimum dimensions of the containers straps** **width (c) × thickness (d)** (mm)	**Minimum dimensions for the bolt** **bolt thread diameter (e) and pitch (p)** (mm)	**Self-threading insert** **external thread diameter (g) and length (f)** (mm)	
	a × b	**c × d**	**e × p**	**g**	**f**
Up to 85	30 × 1,5	20 × 3	8 × 1,25	12	18
	25 × 2,5	30 × 1,5	8 × 1,25	12	18
85 - 100	30 × 1,5	30 × 3	10 × 1,5	14	22
	25 × 2,5	20 × 3 [a]	8 [a] × 1,25	12	18
100 - 150	50 × 2	50 × 6	12 × 1,75	16	26
	30 × 3	50 × 3 [b]	10 [b] × 1,5	14	22

[a] In this case, the container shall be secured by at least three container straps.

[b] In this case, the container shall be secured by at least four container straps.

Containers and securing attachments shall be galvanically compatible.

NOTE 2 It is important that particular attention be given to the effects of galvanic corrosion when containers, anchorages and fixings are in contact with seawater.

Container straps shall be arranged so as to avoid the entrapment of moisture.

The mounting method shall not weaken the craft structure; and reinforcement shall be added where necessary. The mounting shall not compromise the watertight integrity of the hull skin.

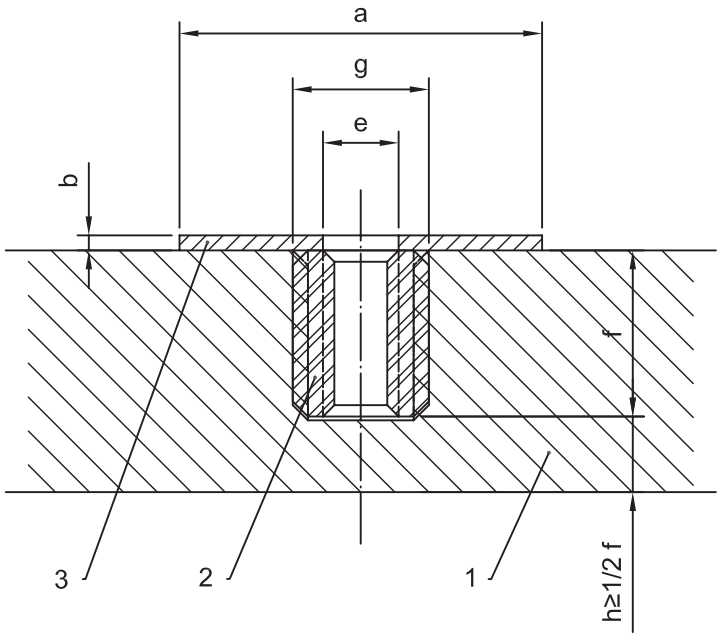
Where anchor bolts pass through a hollow section, a spacer tube shall be provided to prevent the collapse of that section when under load.

Where the container straps also support the weight of the container, a minimum of three container straps shall be provided.

Container straps shall ensure that the container is not allowed to slide, rotate or become dislodged.

Protective material such as plastic shall be inserted between the container and the straps.

Containers shall not be installed in the suspended position (i.e. attached to the deckhead).



Key

1 Thermo-set craft hull
2 Self-threading insert
3 Washer

NOTE For dimensions (a) to (g), see Table A.1.

Figure A.1 — Example of container strap self-threading insert (see Table A.1)

A.2 Container frame

Where the container is secured to the craft by a container frame and straps, a minimum of two straps shall be used.

Annex B
(normative)

Fixing requirements for containers with a capacity over 150 l

B.1 General requirements

For containers over 150 l, a calculation method shall be used to demonstrate the suitability of the fixing arrangement. This method shall take into account the specifications for the container, the container frame (if any) and the structure of the craft where it is to be fixed. This calculation method shall be certified by an inspection body.

B.2 Container frame

Where the container is secured to the craft by a container frame and container straps, a minimum of three straps shall be used.

Annex C
(normative)

Cylinder securing requirements

C.1 Where LPG cylinders are intended to be removed for refilling or replacement, the cylinders shall be rigidly secured to the craft.

Removable LPG cylinders shall be secured to the craft by a cylinder frame and straps. The cylinder shall be secured to the frame by a minimum of two straps.

Dedicated forklift truck type LPG cylinder mounting brackets are permitted for use when permanently fixed to the structure of the craft.

C.2 For permanently installed LPG cylinders, the requirements of this Standard for the fixing of LPG cylinders shall be met when:

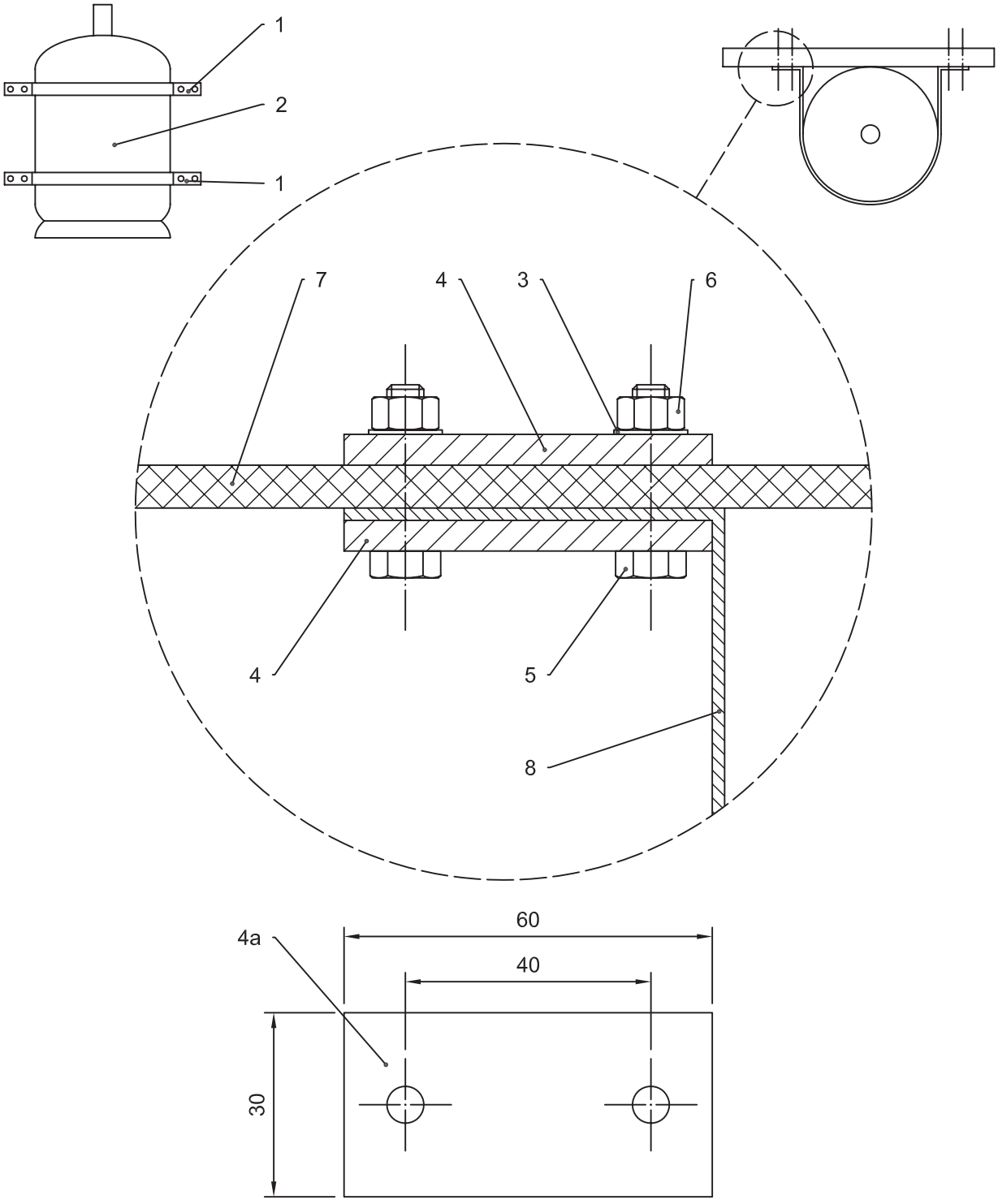
— the cylinder is secured to the craft by at least two straps, made from steel with a minimum tensile strength of grade E 235 B according to ISO 630; and

— at least two bolts per strap including washers and the fixing bolts are of Class 8.8 according to EN ISO 898-1:2009; and

— the dimensions are as specified in Figure C.1 and Figure C.2 for a cylinder of capacity of not more than 16 kg.

C.3 For cylinders of capacity of more than 16 kg, a calculation method shall be used to demonstrate the suitability of the fixing arrangement.

Dimensions in millimetres

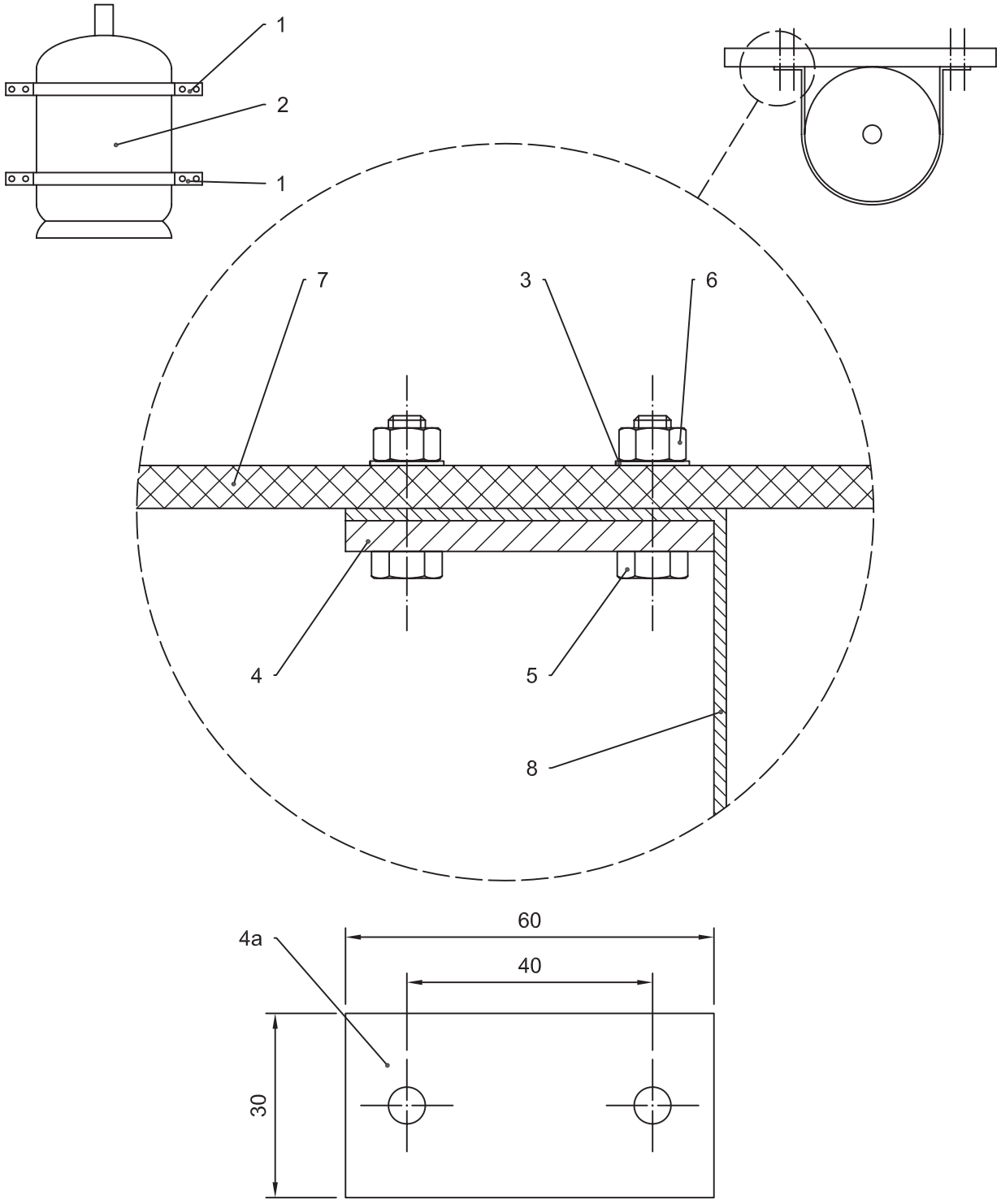


Key

1	Cylinder strap (350 kg breaking load)	5	Stainless steel bolt Ø 6, A 316L (3 mm)
2	13 kg cylinder	6	Stainless steel nut Ø 6, A 316L (3 mm)
3	Washer	7	Composite support (5 mm) or
4	Stainless steel plate A 316 (3 mm)		Wood support (5 mm)
4a	Stainless steel plate A 316 – Plan view	8	Strap

Figure C.1 — Fixing requirements for 13 kg cylinders on supports made of composite or wood

Dimensions in millimetres



Key

1	Container strap (350 kg breaking load)	5	Stainless steel bolt Ø 6, A 316L
2	13 kg cylinder	6	Stainless steel nut Ø 6, A 316L
3	Washer	7	Aluminium support (4 mm) or Steel support (3 mm)
4	Aluminium plate (4 mm) or Steel plate (3 mm)	8	Strap
4a	Aluminium/steel plate – Plan view		

Figure C.2 — Fixing requirements for 13 kg cylinders on supports made of aluminium or steel

Annex D
(normative)

Instructions to be included in the owner's manual

D.1 General requirements

The owner's manual shall be in accordance with EN ISO 10240, and shall include instructions for the operation and maintenance of the LPG system, including user instructions supplied by the manufacturers of the installation equipment. It shall also contain, at a minimum, the following instruction:

"Before sailing to a foreign coast, any restrictions on the use of LPG fuelling systems shall be established and all necessary actions taken".

D.2 Availability of LPG supply

The following warning shall appear in the owner manual.

WARNING — Before sailing, the owner shall take on board sufficient fuel for the intended journey, taking into account the risk of changes in weather conditions.

D.3 Position and operation of emergency shut-off valve

The position and operation of the emergency shut-off-valve shall be clearly illustrated in the owner's manual.

D.4 Safety instructions to be included in the manual

D.4.1 The following safety-related instructions and warnings shall appear in the owner's manual.

— Regularly check all connections for leakage.

— **WARNING — DO NOT USE SOLUTIONS CONTAINING AMMONIA.**

— **WARNING — NEVER USE A FLAME TO CHECK FOR LEAKS.**

— Do not obstruct access to LPG system components in any way.

— Keep valves on empty cylinders closed and disconnected. Keep protective covers, caps or plugs in place. Store reserve cylinders in ventilated housings on open decks or in gastight lockers which are vented overboard and intended for that purpose.

— Keep any unconnected LPG cylinders, whether full or empty, secured in a manner similar to the cylinders connected to the system.

— Do not use LPG cylinder housings or cylinder lockers for storage of any other equipment.

— **WARNING — Do not smoke or use an open flame when replacing LPG cylinders.**

— Inspect hoses in the LPG system regularly (at least annually), and replace with hoses of the same type approval if any deterioration is found.

D.4.2 Details of the technical specifications shall be included such as:

— description of the system;

— restrictions imposed by the fuel mixture;

— information on running in and/or adjustments.

D.4.3 The safety instructions shall also include:

— instructions on the safe use of the system;

— measures to be taken in the event of detection of a gas leak;

— measures to be taken in the event of any negative effect caused by temperature or humidity (e.g. starting problems due to the vaporisation of liquid fuel in the fuel pipe in very hot weather).

NOTE Cylinders with LPG (either filled or empty uncleaned) are subject to provisions for the transport of dangerous goods when transported outside of the craft e.g. for replacement, repair, refill or disposal. This also applies to containers and equipment of craft, when transported with residues of LPG e.g. in case of disposal.

D.5 Instruction for the normal use of the LPG system

D.5.1 Filling of the LPG system

The sequence of the operations necessary to fill the LPG fixed container shall be included in the instructions.

An instruction to the user shall be included highlighting that special attention shall be paid to the maximum filling level of 80 % of the total volume of the container installed in the craft. In the case of malfunction of the automatic filling system at 80 %, the user shall manually stop filling at 80 % of the total volume of the container.

D.5.2 Switching procedure (for dual-fuelled craft)

The sequence of the operations necessary to switch fuels shall be included in the instructions.

D.5.3 Opening and closing of manual valves (in the case of multiple containers)

Specify the operating procedure for the operation of each manual valve.

D.5.4 Liquid level indicator

Identify the position of the liquid level indicator(s), for example on the instrument panel or on the container.

D.5.5 Maintenance and inspection

Specify the periodic maintenance requirements for the LPG fuel system, the safety control system and any other extra checks for dual-fuel craft.

All maintenance operations shall include an inspection of all valves and connectors for corrosion, damage or leaks, and repair or replacement if necessary.

Hoses shall be replaced at least every five years.

For all container(s):

a) checks and tests shall be performed by a competent person;

b) external visual check of the container(s) and its (their) components, including the pressure relieve valve, shall be done every year by checking for signs of deterioration, corrosion or leaks which can necessitate the container(s) removal;

c) LPG container(s) shall be periodically examined and re-qualified; fixed containers shall be re-qualified in accordance with ISO 20826 or per national requirements;

d) accuracy of the overfill protection device shall be checked when practicable, (as a minimum at the container re-qualification);

e) accuracy of the gas detector shall be checked per the manufacturer's instructions.

D.5.6 Defects and repairs

The manual shall indicate the procedure to be followed in cases of defect and repair of a faulty component in the fuel system.

When the LPG system is equipped with a fault-finding system, the manual shall describe this system by indicating the measures to be taken.

D.5.7 Storage, repair and maintenance

Craft using LPG in their propulsion system can be laid up, maintained and repaired inside boatyards provided that the following conditions are complied with:

a) Only competent persons are permitted to work on the engine’s LPG system;

b) The system shall not have any leaks and the fuel containers shall not be filled over 80 %;

c) The craft shall not be positioned less than 3 m from any fixed source of ignition;

d) The LPG-propelled craft undergoing repair at the boatyard shall have the LPG container(s) shut-off valve closed. LPG shall be emptied from the service line, either by running the engine or, if it’s not possible, by disconnecting it in the open air so that LPG cannot accumulate locally or in bilges. This does not apply if LPG is required for operating the engine; and

e) The LPG cylinders shall be stored ashore when the craft is not used for a long period of time.

D.5.8 Disposal

When the craft is to be scrapped, all LPG containers shall be emptied before being removed for scrapping or reuse.

WARNING — LPG containers shall be handled with care as they may contain residues of fuel.

In order to make them unusable as fixed LPG containers, those being disposed of shall be destroyed under the supervision of a competent person and in a manner rendering them unserviceable for containing gas.

NOTE 1 EN 13109:2010 details the disposal of containers in excess of 150 l.

NOTE 2 EN 12816:2010 details the disposal of cylinders and containers up to 150 l.

NOTE 3 Cylinders with LPG (either filled or empty uncleaned) are subject to provisions for the transport of dangerous goods when transported outside of the craft e.g. for replacement, repair, refill or disposal. This also applies to containers and equipment of craft, when transported with residues of LPG e.g. in case of disposal.

D.5.9 Hot work

On a craft where welding is to be done or heat is to be applied on any part positioned less than 1 m from the LPG container, fuel lines shall be emptied and the container/cylinders shall be removed from or protected against the heat source. This operation shall only be carried out by competent persons.

No hot work (e.g. welding, cutting or bending) shall be carried out on a craft unless the hazard related to the container or LPG system has been eliminated.

Annex E
(normative)

Additional test requirements for vaporisers

E.1 Vaporisers used in a closed loop cooling system shall be tested by being submerged in a heat exchange medium for 168 hours at 90 °C; they shall then be dried for 48 hours at a temperature of 40 °C. The composition of the heat exchange medium used for the test shall be a water/ethylene-glycol fluid of 50 %/50 %.

E.2 Vaporisers used in an open loop cooling system shall be submerged in a heat exchange medium for 168 h at 90 °C; they shall then be dried for 48 hours at a temperature of 40 °C. The heat exchange medium used for the test shall be distilled or deionised water with a concentration of (50 ± 5) g/l of sodium chloride.

The sodium chloride shall contain less than 0,001 % mass fraction of copper and less than 0,001 % mass fraction of nickel, as determined by atomic absorption spectrophotometry or another analytical method of similar sensitivity. It shall not contain more than 0,1 % of a mass fraction of sodium iodide, or more than 0,5 % of a mass fraction of the total impurities calculated for dry salt.

NOTE 1 Dissolve a sufficient mass of sodium chloride in distilled or deionized water with a conductivity not higher than 20 µS/cm at (25 ± 2) °C to produce a concentration of (50 ± 5) g/l. The specific gravity range for a (50 ± 5) g/l solution is 1,029 to 1,036 at 25 °C.

NOTE 2 Where the pH of prepared solution at (25 ± 2) °C is outside the range 6,0 to 7,0, the presence of undesirable impurities in the salt and/or the water should be investigated.

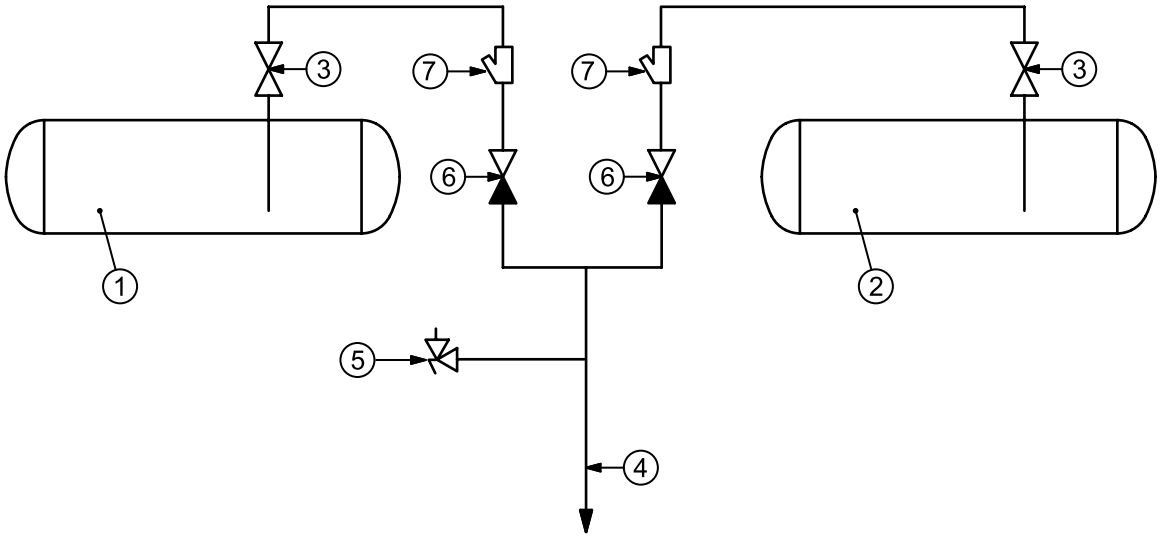
E.3 After the relevant test, the inside surfaces of the test sample shall be wiped clean of any loose material and shall meet the requirements specified in Table E.1.

Table E.1 — Corrosion on the vaporiser's internal surfaces

Type of corrosion	Description	Rejection limit
Isolated corrosion pits	A pitting of metal occurring in isolated areas at a concentration not greater than 1 pit per 500 mm^2 of surface area	When the depth of discrete pits exceeds 0,6 mm[a)].
Area corrosion	Reduction in material thickness over an area not exceeding 20 % of the surface area	When the depth of penetration of any pit exceeds 0,4 mm[a)].
General corrosion	A reduction in material thickness over an area exceeding 20 % of the surface area	When the depth of penetration of any pit exceeds 0,2 mm[a)]
Chain pitting or line or channel corrosion	A series of pits or corroded cavities of limited width along the length or around the outer edge circumference	1) When the total length of corrosion in any direction exceeds 50 % of the circumference of the outer edge or 2) When the depth of penetration exceeds 0,4 mm[a)]
[a)] A greater depth can be accepted provided that the depth of corrosion does not reduce the material thickness below the minimum calculated material thickness.		

Annex F
(informative)

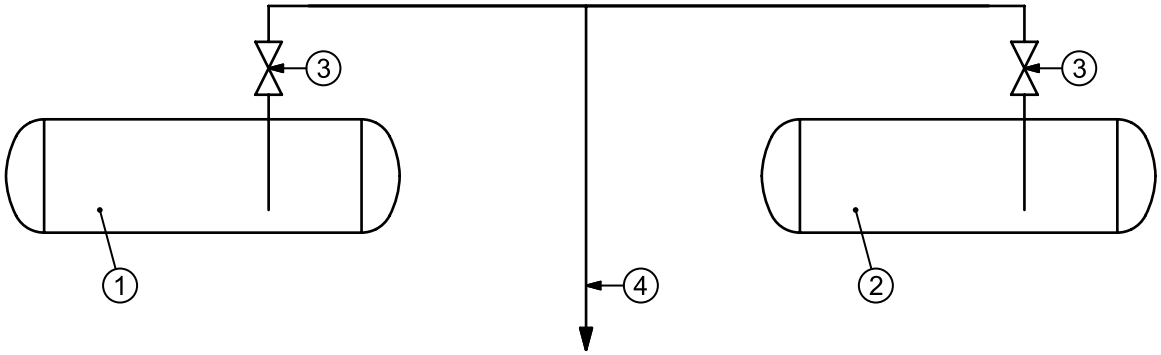
Installation of more than one container



Key

1 Container 1
2 Container 2
3 Remote controlled service valve
4 Supply to engine
5 Hydrostatic relief valve
6 Non-return valve
7 Filter

Figure F.1 — Differential pressure of service valve in opposite flow direction ≤ 5 bar



Key

1 Container 1
2 Container 2
3 Remote control service valve
4 Supply to engine

Figure F.2 — Differential pressure of service valve in opposite flow direction > 5 bar

Annex G
(informative)

Example of installation certificate

Owner	**LPG container/s** (only for fixed containers)
Name and address:	Manufacturer:
	Serial Number(s):
Installer	Type approval marking(s):
Name and address:	Maximum water capacity(s):
	Test date/retest date(s):
Certificate No.:	
Craft	
Type and model:	Maximum number of containers allowed to be connected simultaneously:
Year of manufacture:	
Registration No./Hull Identification Number:	Date of installation:
Manufacturer:	
Type approval:	Gas sensors are fitted at the following locations:
Engine/s	
Type and model:	
Year of manufacture:	
Manufacturer:	
This certifies that the LPG equipment in the above craft, after installation, test and approval, is in conformity with EN 15609.	
Name:	Signature:
Name and address of the organisation approving the installation:	
Date:	

Annex H
(informative)

Example LPG identification label

H.1 The label shall be a weather-resistant sticker.

H.2 The colour and dimensions of the sticker should fulfil the following requirements:

a) Colours:

1) Background : green

2) Border : white or white reflecting

3) Letters : white or white reflecting

b) Dimensions:

1) Border width: 4 mm – 6 mm

2) Character height: 25 mm

3) Character thickness: 4 mm

4) Sticker width: 110 mm – 150 mm

5) Sticker height : 80 mm - 110 mm

H.3 The word "LPG" should be centred in the middle of the sticker as detailed in Figure H.1.

Figure H.1 — LPG label

Annex I
(informative)

Environment 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	5.3.2		5.2.3							D.5.8	
Water											
Energy											
Land											
Outputs											
Emissions to air		5.8.1.2	7.1								
Discharges to water			4.1								
Discharges to soil											
Waste											
Noise, vibration, radiation, heat losses											
Other relevant aspects											
Risk to the environment from accidents or unintended use											
Customer information					6						
Comments:											

Annex ZA
(informative)

Relationship between this Standard and the Essential Requirements of EU Directive 94/25/EC amended by EU Directive 2003/44/EC

This standard has been prepared under a mandate given to CEN by the European Commission and European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 94/25/EC amended by Directive 2003/44/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one member state, compliance with the normative clauses of this standard as given in Table ZA.1, confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this standard and Directive 94/25/EC

Clauses/sub-clauses of this standard	Essential Requirements of EU Directive 94/25/EC amended by 2003/44/EC	Qualifying remarks/notes
5.1.12	Annex IA, 2.4, Visibility from the main steering position	
7 Annex D	Annex IA, 2.5, Owner's manual	
5.4.2	Annex IA, 3.2, Stability and freeboard	
5.5.1.1	Annex IA, 3.8, Escape	
5.12	Annex IA, 5.1.2, Ventilation of engine compartment	
4, 5 & 8 Annex E	Annex IA, 5.2.1, Fuel system, General	
4.2 & 5.5 Annexes A, B & C	Annex IA, 5.2.2, Fuel tanks	
5.9	Annex IA, 5.3, Electrical system	
4, 5 & 8	Annex IA, 5.5, Gas system	Only as applicable for LPG propulsion systems
4, 5 & 8	Annex IA, 5.6.1 Fire protection general	

6	AnnexIA, 5.6.2 Fire-fighting equipment	
4.2 Annexes A, B & C	Annex II, Components, 4, Fuel tanks and fuel hoses	CE marking, is required only for fuel tanks or hoses assessed as components in accordance with Annex II, Clause 4 when placed on the market separately. Fuel tanks may be CE marked underEU Directive 97/23/EC. Fuel hoses will require a specification or standard.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 3-7, *Portable fire extinguishers - Part 7: Characteristics, performance requirements and test methods*

[2] EN 589, *Automotive fuels — LPG — Requirements and test methods*

[3] EN 12816:2010, *LPG equipment and accessories — Transportable refillable LPG cylinders — Disposal*

[4] EN 12979, *Automotive LPG-systems — Installation requirements*

[5] EN 13109:2010, *LPG equipment and accessories — LPG tanks and drums — Disposal*

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

[7] Directive 2003/44/EC of the European Parliament and of the Council of 16 June 2003 amending Directive 94/25/EC on the approximation of the laws, regulations and administrative provisions of the Member States relating to recreational craft

[8] Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment

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