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**Small craft — Liquefied petroleum gas  
(LPG) systems**

*Petits navires — Installations alimentées en gaz de pétrole liquéfiés (GPL)*

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## Contents

	Page
Foreword.....	iv
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	2
4 General provisions .....	3
5 Pressure-reduction system .....	4
6 LPG supply-line system .....	4
7 Appliances.....	7
8 Location and installation of LPG cylinders.....	7
9 Ventilation.....	8
10 LPG installation system tests.....	8
11 Electrical devices for ignition protection .....	8
12 Owner's manual .....	9
13 Ducts and flues for air intake and combustion-product discharge.....	9
Annex A (informative) Design guidelines for pressure drop due to pipe resistance.....	10
Annex B (informative) Ventilation.....	11
Annex C (normative) Instructions to be included with the owner's manual.....	12

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

International Standard ISO 10239 was prepared by Technical Committee ISO/TC 188, *Small craft*.

Annex C forms a normative part of this International Standard. Annexes A and B are for information only.

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# Small craft — Liquefied petroleum gas (LPG) systems

## 1 Scope

This International Standard covers permanently installed LPG systems and LPG burning appliances on small craft of hull length up to 24 m, except for systems used on LPG-fueled propulsion engines or LPG-driven generators.

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

NOTE 1 This International Standard is not intended to regulate technical requirements for LPG cylinders, which are subject to national regulations.

NOTE 2 New designs, materials and methods of assembly giving at least equivalent results may be considered as complying with the requirements of this International Standard when approved by a relevant body.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 8846:1990, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases.*

ISO 9094-1:—<sup>1)</sup>, *Small craft — Fire protection — Part 1: Craft with a hull length of up to and including 15 m.*

ISO 10133:—<sup>2)</sup>, *Small craft — Electrical systems — Extra-low-voltage d.c. installations.*

ISO 10240:1995, *Small craft — Owner's manual.*

ISO 13297:—<sup>3)</sup>, *Small craft — Electrical systems — Alternating current installations.*

EN 751-2:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 2: Non-hardening jointing compounds.*

EN 751-3:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes.*

1) To be published.

2) To be published. (Revision of ISO 10133:1994)

3) To be published. (Revision of ISO 13297:1995)

EN 1763-1:—<sup>4)</sup>, *Flexible hose, tubing and assemblies for use with propane and butane in the vapour phase — Part 1: Requirements for rubber and plastics hoses and tubing — Specification.*

EN 1763-2:—<sup>4)</sup>, *Flexible hose, tubing and assemblies for use with propane and butane in the vapour phase — Part 2: Requirements for nozzles, couplings and assemblies.*

### 3 Terms and definitions

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

#### 3.1

##### **liquefied petroleum gas**

##### **LPG**

mixture of light hydrocarbons, gaseous under conditions of normal temperature and pressure, and maintained in the liquid state by increase of pressure or lowering of temperature

NOTE 1 The principal components are propane, propene, butanes or butenes.

NOTE 2 LPG can be obtained as commercial butane, commercial propane or a mixture of the two.

#### 3.2

##### **cylinder housing**

ventilated enclosure intended solely for storage of one or more LPG cylinders, pressure regulators and safety devices and located on the exterior of the craft, where any leakage would flow overboard

#### 3.3

##### **cylinder locker**

vapour-tight enclosure with an overboard drain intended solely for storage of one or more LPG cylinders in a cockpit or recessed into the craft (see 8.3)

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#### 3.4

##### **room-sealed appliance**

appliance having a combustion system in which incoming combustion air and outgoing products of combustion pass through sealed ductwork connected to the enclosed combustion chamber

#### 3.5

##### **LPG system**

system consisting of an arrangement of cylinder(s), safety device(s), pressure regulator(s), connection(s), valve(s), piping, tubing, hose, fitting(s) and devices intended to store, supply, monitor or control the flow of fuel gas up to and including the appliance

NOTE The cylinders are replacement items and may not be supplied with the LPG system in the craft.

#### 3.6

##### **accessible**

capable of being reached for inspection, removal or maintenance without removal of a permanent part of the craft structure, with or without the use of tools

#### 3.7

##### **readily accessible**

capable of being reached quickly and safely for effective use under emergency conditions without the use of tools

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4) To be published.

**3.8****unattended appliance**

appliance intended to function without constant attention by an operator and which may cycle on and off automatically, such as water heaters, refrigerators or cabin heaters

NOTE Stoves and ovens are not considered to be unattended appliances.

**3.9****supply-pressure side**

part of the LPG supply line directly exposed to pressure at the inlet of a pressure regulator in a liquefied petroleum gas system

NOTE Vapour pressure propane at 20 °C = 0,7 MPa (7 bar)

Vapour pressure butane at 20 °C = 0,175 MPa (1,75 bar)

**3.10****low-pressure side**

part of the LPG supply line exposed to the regulated pressure of the gas regulator

**3.11****pressure-reduction system (regulator or regulators)**

devices used in the LPG system to reduce the gas pressure present in the LPG cylinder to the working pressure of the appliances and maintain that pressure during use

**3.12****pipng**

pipeline of rigid metallic construction

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**3.13****hose**

pipeline of flexible material

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**3.14****shut-off valve**

device to isolate an appliance from the gas supply

**3.15****main shut-off valve**

device to isolate the entire LPG system from the supply-pressure side

**3.16****permanent label**

indelibly marked label secured in place

**3.17****flame-supervision device**

device that has a sensing element, activated by presence or absence of a flame, that causes the inlet of the LPG supply to a burner to be opened or closed

NOTE See EN 125.

**4 General provisions**

**4.1** An LPG system and all its components shall be capable of withstanding storage at – 30 °C to + 60 °C, as well as vibration and exposure in a marine environment.

**4.2** LPG systems shall be of the vapour-withdrawal type, i. e. fuel released only under gas-phase conditions.

4.3 All LPG appliances installed on the craft shall be designed for use at the same working pressure.

## 5 Pressure-reduction system

5.1 Each LPG system shall be equipped with, or have provision for installation of, a pressure-reduction system (3.11) designed to provide a fixed working pressure suitable for the consuming appliances but not more than 0,005 MPa (50 mbar). If a pressure regulator is not supplied with the system, a label indicating the working pressure of the LPG appliances installed shall be affixed in the vicinity of the LPG cylinder installation.

5.2 The LPG pressure-reduction system shall have an overpressure device to prevent uncontrolled pressure increase in the low-pressure side. Any gas discharge of the device shall be inside the cylinder locker or housing or shall be separately vented outside the craft. The device may be a pressure-relief governor, pressure-relief valve or an automatic safety shut-off valve.

5.3 The nominal regulated working pressure shall be indicated on the pressure regulator.

5.4 Pressure regulators of the external manual-adjustment type shall not be fitted.

5.5 The pressure regulator shall be located within the cylinder locker or housing.

5.6 If not rigidly connected to, and supported by, the cylinder connection, the pressure regulator shall be separately secured within the cylinder locker or cylinder housing to protect it from damage and exposure to dirt and water.

5.7 Pressure regulators shall be made of corrosion-resistant metallic material or have an coating, such as paint or plastic, that is effective against external corrosion. Fasteners used shall be of corrosion-resistant material or have a corrosion-resistant plating or coating.

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## 6 LPG supply-line system

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### 6.1 General

6.1.1 The LPG supply-line system shall be either a solid piping system in accordance with 6.2, except for short hose connections to gimbaled stoves, or continuous hoses in accordance with 6.3.

6.1.2 Hoses shall be used to connect gimbaled stoves to their LPG supply, and supply piping to the pressure regulator. The hose and its connections between supply piping and the pressure regulator shall be within the cylinder locker or cylinder housing.

6.1.3 The piping and hose shall be sized so that the pressure drop due to pipe resistance does not reduce the working pressure at any appliance below the value required by the appliance manufacturer when all appliances are operating simultaneously. See annex A for guidance.

### 6.2 Piping

6.2.1 Only solid drawn copper piping or drawn stainless steel piping, which are galvanically compatible, shall be used for rigid supply lines. The minimum wall thickness for piping of outside diameter equal to or less than 12 mm shall be 0,8 mm and 1,5 mm for piping of outside diameter greater than 12 mm.

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

6.2.3 Metallic LPG supply piping routed through engine compartments shall be protected by conduit or trunking or be supported by non-abrasive attachments which are no more than 300 mm apart.



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

- hard soldered connections;
- cutting-ring fittings (see 6.4.4 and 6.4.5);
- compression fittings made of copper alloy with solid- or thick-walled copper rings on copper piping;
- stainless steel rings on stainless steel piping.

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.

**6.2.5** Piping shall be installed as high as practicable above the bilge water level.

**6.2.6** Supply piping shall be made up with as few fittings as practicable. Joints and fittings shall be readily accessible.

### 6.3 Hoses and hose lines

**6.3.1** Hose assemblies for LPG installations shall meet the requirements of EN 1763-1 and EN 1763-2, Class 2 or 3 for the low-pressure side and Class 3 or 4 for the supply-pressure side.

**6.3.2** Hoses shall not be routed through an engine compartment.

**6.3.3** Hoses shall have permanently attached end fittings, such as swaged sleeve or sleeve and threaded insert, in accordance with EN 1763-2, and shall be accessible for inspection over their entire length. Connections shall be readily accessible.

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

**6.3.5** Hose used for the LPG supply line shall be continuous and have no joints or fittings from within the cylinder locker or cylinder housing to the appliances, or the readily accessible shut-off valve near the appliance (see 6.6.3) except where metallic supply piping is connected to a flexible hose leading to a movable appliance, such as a gimbaled stove.

### 6.4 Materials

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

**6.4.2** Fittings shall be galvanically compatible with the metallic piping to which they are connected.

**6.4.3** Hose clamps, if used to secure cylinder-locker vent hoses, shall be made of corrosion-resistant material, such as stainless steel, of type 18Cr 8Ni, or equivalent, and be reusable.

**6.4.4** End-connecting fittings shall be of corrosion-resistant material such as brass or stainless steel. Brass end fittings and cutting rings shall not contain more than 15 % zinc.

**6.4.5** 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. of the same series.

### 6.5 Installation

**6.5.1** Piping shall not have direct contact with metallic parts of the craft structure.

**6.5.2** LPG supply lines and components shall be routed at least 30 mm away from electrical conductors, unless the LPG supply line passes through a jointless conduit, or the conductors are sheathed or in conduit or trunking in accordance with ISO 10133 and ISO 13297.

**6.5.3** LPG supply lines shall be at least 100 mm from components of the engine exhaust system. Metallic LPG lines shall be at least 100 mm from exposed terminals of electrical devices or accessories.

**6.5.4** LPG supply lines 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. For copper or stainless steel piping, such fixing devices shall be pipe rings spaced at intervals not exceeding 0,5 m, and for lines of other materials the fixing devices shall be spaced at not more than 1 m. The fixing devices shall be corrosion resistant, non-abrasive, designed to prevent cutting or other damage to the lines and compatible with the line material.

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

**6.5.6** 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.

**6.5.7** Supply piping and hoses shall be protected from abrasion or chafing at the point where they pass through walls or bulkheads.

**6.5.8** All threaded connections required to ensure gas tightness of the system shall be of the taper-pipe-thread type conforming with ISO 7-1 and using sealants conforming to EN 751-2 or EN 751-3. Sealants shall be applied to the male thread only, before assembly.

## **6.6 Shut-off valves**

**6.6.1** Each LPG system shall be equipped with a readily accessible manually operated main shut-off valve in the supply-pressure side. The main shut-off valve can be the cylinder valve. The main shut-off valve may be incorporated in the regulator, as long as its action isolates the cylinder contents from the regulator input and removal of the pressure regulator from the cylinder closes the cylinder valve.

**6.6.2** A dual cylinder system shall be provided with an automatic or manual change-over device (selector valve), in addition to each cylinder shut-off valve, to prevent the escape of gas when either cylinder is disconnected.

**6.6.3** A shut-off valve shall be installed in the low-pressure supply line to each appliance. The valve or its control shall be readily accessible and operable from within the vicinity of the appliance, and operable without reaching over the top of open-flame appliances such as stoves. If there is only one appliance in the system and the main shut-off valve at the cylinder is readily accessible from the vicinity of the appliance, the shut-off valve on the low-pressure supply line is not required.

**NOTE** A solenoid valve located within the cylinder locker or cylinder housing, operable from the vicinity of the appliance, is considered as meeting this requirement

**6.6.4** Controls of shut-off valves in the low-pressure side of the system shall be readily accessible. Unmistakable and easily recognized means of identifying the open and closed positions shall be provided.

**6.6.5** For shut-off valves which are not located immediately adjacent to the appliance that they control, means of identifying the appliance controlled shall be provided. If a valve is not visible, its location shall be clearly indicated with a visible and permanent label.

**6.6.6** Taper-plug type valves shall be spring loaded and may be used only in the low-pressure side of the system.

**6.6.7** Shut-off valves shall be located such that inadvertent or accidental operation is avoided.

**6.6.8** Needle valves shall not be used as shut-off valves in the low-pressure side of the system. Gate valves shall not be used as shut-off valves.

## 7 Appliances

**7.1** Only appliances specifically designated by the manufacturer for use with LPG in a marine environment shall be installed in the system. They shall be fitted in accordance with the manufacturer's instructions for installation in small craft.

**7.2** Each LPG-consuming appliance shall be securely fixed to the craft so as to eliminate undue stress on piping, hose and fittings.

**7.3** Each gas-consuming appliance, including gas lamps, shall be equipped with flame-supervision devices which control all burners and pilot lights.

**7.4** All unattended appliances shall be of the room-sealed type (see 3.4 and 3.8), with air-intake ducting and flues for outgoing products of combustion terminating outside the craft, including any areas that can be enclosed by canopies.

**7.5** Each appliance shall be labelled to indicate the type of LPG to be used as fuel, for example "PROPANE" or "BUTANE". Additionally, the label shall refer to the owner's manual.

**7.6** For cooking appliances, a permanent, legible warning label, with a minimum character height of 4 mm, shall be affixed in a conspicuous position, on, or adjacent to, the appliance (cooking stove or oven) which shall provide at least the following information in a language acceptable in the country of intended use:

**DANGER — AVOID ASPHYXIATION. PROVIDE VENTILATION WHEN THE STOVE IS IN USE. DO NOT USE FOR SPACE HEATING.**

**7.7** The proximity and flammability of materials in relation to appliances shall be in accordance with ISO 9094-1.

**7.8** Space heaters and water heaters installed in exposed locations in accommodation spaces of small craft shall be installed with regard to the risk of injury due to inadvertent contact with hot working surfaces.

**7.9** A free area shall be provided around appliances, in accordance with ISO 9094-1 and the manufacturers instructions, that is sufficient to prevent overheating of adjacent surfaces and permit inspection and servicing.

**7.10** Means shall be provided on or adjacent to stove-top cooking surfaces to prevent both deep and shallow cooking utensils from sliding across or off the stove during craft motion, at pitch angles up to 15° or roll angles up to 30° for monohull sailing craft, 15° angles of pitch or roll for engine driven and multihull sailing craft.

## 8 Location and installation of LPG cylinders

**8.1** LPG cylinders, regulators and safety devices shall be secured against any movement that is expected to result from marine service.

**8.2** LPG cylinders, pressure regulators and safety devices shall be installed in cylinder lockers or cylinder housings.

**8.3** Cylinders, pressure regulators and safety devices located below decks or in cockpits shall be mounted in cylinder lockers which, when closed, are vapour-tight to the craft interior, openable only from outside the craft interior, vented at the bottom by a drain of not less than 19 mm inside diameter or the equivalent area if not circular.

**8.3.1** The locker drain shall be run outboard, i. e., to the outside of the craft, and

— without sumps which can retain water, and

— with the outlet at a level lower than the locker bottom and as high as practicable, but not less than 75 mm above the at-rest waterline in the fully loaded ready-for-use condition.