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القوارب (المراكب) الصغيرة - أنظمة الغاز البترولي المسال
Small craft -- Liquefied petroleum gas (LPG) systems



المواصفات القياسية السعودية
SAUDI STANDARDS

تقديم وطني

قامت الهيئة العربية السعودية للمواصفات والمقاييس بتبني المواصفة القياسية الدولية التالية دون إدخال أي تعديلات فنية عليها:
"ISO10239:2008 القوارب (المراكب) الصغيرة - أنظمة الغاز البترولي المسال "

NATIONAL FOREWORD

The Saudi Standards, Metrology and Quality (SASO) has adopted without any technical changes the International Standard:
"ISO10239:2008" Small craft -- Liquefied petroleum gas (LPG) systems"

**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.....	1
4 General provisions	3
5 Pressure reduction system.....	4
6 LPG supply line system	4
6.1 General.....	4
6.2 Piping	5
6.3 Hoses and hose lines	5
6.4 Materials	5
6.5 Installation	6
6.6 Shut-off valves	6
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 sources	9
12 Owners 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 (normative) Ventilation.....	11
Annex C (normative) Instructions to be included with the owner's manual	12
Bibliography	14

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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 10239:2000), which has been technically revised. It also incorporates the Technical Corrigendum ISO 10239:2000/Cor.1:2001.

Small craft — Liquefied petroleum gas (LPG) systems

1 Scope

This International Standard covers permanently installed liquefied petroleum gas (LPG) systems and LPG burning appliances on small craft of hull length up to 24 m, except for systems used on LPG-fuelled 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 and 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 can be considered to be complying with the requirements of this International Standard when approved by a relevant body.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2928, *Rubber hoses and hose assemblies for liquefied petroleum gas (LPG) in the liquid or gaseous phase and natural gas up to 25 bar (2,5 MPa) — Specification*

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

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

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

ISO 10240, *Small craft — Owner's manual*

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

3 Terms and definitions

For the purposes of this document, 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 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

NOTE See 8.3.

**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 maintenance or effective use under emergency conditions without the use of tools

**3.8
unattended appliance**
appliance intended to function without the constant attention of an operator and which may cycle on and off automatically

NOTE Examples of unattended appliances are water heaters, refrigerators and cabin heaters. Stoves, ovens and gas lamps are not considered to be unattended appliances.

**3.9
high 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 1 Vapour pressure propane at 20 °C = 0,7 MPa¹⁾.

NOTE 2 Vapour pressure butane at 20 °C = 0,175 MPa.

**3.10
low pressure side**
part of the LPG supply line exposed to the regulated pressure of the gas regulator

1) 0,1 MPa = 1 bar.

3.11**pressure regulation system**

system incorporating one or more regulators to reduce the high pressure of the system to the required nominal pressure of the appliances

3.12**pipng**

pipeline of rigid metallic construction

3.13**hose**

pipeline of flexible material

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 high 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.

3.18**nominal pressure**

nominal inlet pressure of the LPG appliances

4 General provisions

4.1 An LPG system and all its components shall be capable of withstanding storage at $-30\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$.

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.

4.4 Each system shall be fitted with a pressure gauge. The gauge shall read the cylinder pressure side of the pressure regulator. The gauge scale shall have a pressure range from 0 kPa to a minimum of 1 200 kPa and a maximum of 1 400 kPa.

NOTE The purpose of the gauge is to provide a convenient, simple means to test the system for leakage before each use of the appliances. The gauge does not provide an indication of liquid LPG remaining in the cylinder, only its vapour pressure, which is a constant at any given temperature.

4.5 A sign shall be fixed in the vicinity of the cylinder shut off valve, listing the leak test procedure using the pressure gauge, as described below.

- With appliance valves closed, open the cylinder valve.
- Close cylinder valve. Allow indicated gauge pressure to stabilize.
- Observe pressure on gauge for 3 min.
- If pressure remains constant, no leak is present. If pressure falls, a leak exists. Do not use LPG system until leak is repaired.

5 Pressure reduction system

5.1 Each LPG system shall be equipped with, or have provision for the installation of, a pressure regulation system (see 3.11). This system shall be designed to provide a fixed nominal pressure suitable for the consuming appliances, but not more than 0,005 MPa. 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 to a value below 0,015 MPa. 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, a pressure relief valve or an automatic safety shut off valve.

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

5.4 Pressure regulators with external manual output pressure adjustment 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, and be mounted above the cylinder valve so that the attaching connection to the cylinder valve has a continuous rise to the regulator.

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

NOTE Pressure reduction systems in accordance with EN 12864:2001, Annex M, or in accordance with EN 13786 meet the requirements.

6 LPG supply line system

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 connection to gimballled stoves, or continuous hose in accordance with 6.3.

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

6.1.3 Piping and hose shall be sized so that pressure drop due to pipe resistance does not reduce the nominal pressure at any appliance below that required by the appliance manufacturer when all appliances are operating simultaneously. See Annex A.

6.2 Piping

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

6.2.2 There shall be no joints or fittings in piping passing through engine compartments.

6.2.3 Metallic LPG supply piping routed through engine compartments shall be protected by conduit or trunking, or 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 in accordance with ISO 8434-1:2007, Table 4 (see also 6.4.2, 6.4.4, 6.4.5);
- copper rings on copper piping; stainless steel rings on stainless steel piping;
- connections in accordance with EN 560.

Jointing compound for flared fittings or flared rings shall not be used.

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

6.2.6 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 ISO 2928, Type D, with a nominal bore of not less than 6 mm, or be of equivalent materials and specifications.

6.3.2 Hoses shall not be routed through an engine compartment and shall be of minimum practical length.

6.3.3 Hoses shall have permanently attached end fittings, such as swaged sleeve or sleeve and threaded insert, 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 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 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 not be less than 450 °C.

6.4.2 Fittings through which LPG passes shall be compatible with LPG and 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, type 18 Cr-8 Ni, or other equivalent corrosion-resistant material, and be reusable.

6.4.4 End connecting fittings shall be of corrosion-resistant material, such as brass or stainless steel, or be of equivalent corrosion resistance in a marine environment.

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, except for bulkhead fittings.

6.5.2 LPG supply lines and components shall be routed at least 30 mm away from electrical conductors, unless the LPG supply line is run jointless through 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; for hoses, the intervals shall not exceed 1 m. 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 materials or fittings capable of maintaining the water tightness.

6.5.7 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 taper pipe thread type conforming to ISO 7-1 or fittings conforming to EN 1949, with 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 high 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), with non-return valves fitted, 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. A solenoid valve located within the cylinder locker or cylinder housing, operable from the vicinity of the appliance, is considered as meeting this requirement. Solenoid valves shall be closed in cases of lack of tension, i.e. loss of electrical actuating energy.

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, a means of identifying the appliance controlled shall be provided. If a valve is not visible, its location shall be clearly indicated by means of 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 suitable 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, e.g. "PROPANE" or "BUTANE". In addition, 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). This label 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 minimizing the risk of injury due to inadvertent contact with hot working surfaces.

7.9 Sufficient free area shall be provided around appliances, in accordance with ISO 9094-1 and the manufacturer's instructions, in order to prevent overheating of adjacent surfaces and to permit inspection and servicing.

7.10 Considering the foreseeable locations of craft use, a 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 craft 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 and vented at the bottom by a drain of not less than 19 mm inside diameter or the equivalent area if not circular. The cylinder locker shall be openable only from outside the craft interior. Cylinder lockers located in cockpits may be openable from inside the cockpit if the locker can be opened only from the top.

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

- 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 and above the waterline at a heel angle of 15 degrees when in the fully loaded ready-for-use condition.

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

8.6 Cylinder locker drain openings and cylinder housing ventilation openings shall be located at least 500 mm from any hull opening to the interior of the craft.

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

8.8 Cylinders, valves and pressure regulators shall be installed so that they are readily accessible, and are secured rigidly in their intended position so that only gas in the vapour phase is withdrawn during use.

8.9 Provisions for storage of unconnected LPG cylinders, whether filled or empty, shall be the same as cylinders connected to the system. See 8.2.

9 Ventilation

Ventilation shall be provided in accommodation spaces where open flame unflued appliances are used or to which compartments containing such appliances are connected by open passageways. The design of such ventilation shall take into account the air consumption of the appliances and occupants of the spaces and allow outside air to pass through fixed openings. Minimums for sizing and locations of ventilation openings are given in Annex B.

10 LPG installation system tests

10.1 Before putting the LPG system into operation, verify, from the connection at the pressure regulator to the closed burner valves at the appliances, that the system has been correctly installed; prior to charging the system with LPG, submit it, with shut-off valves open, to an air pressure test at three times the nominal pressure but not more than 0,015 MPa. The system shall be deemed sound if, after a period of 5 min (to allow for pressure equilibrium), the pressure remains constant at $\pm 0,000 5$ MPa for the following 5 min. An appropriate leak detection fluid may be used on connections to locate sources of leakage.

NOTE Foam producing solutions for leak detection on gas installations in accordance with EN 14291 meet these requirements.

CAUTION — Ammonia, which is present in some soaps and detergents, attacks brass fittings. Although damage is undetectable at first, brass fittings may crack and leak within a matter of months after contact with ammonia.

10.2 All connected appliances, including the function of the flame supervision devices at the burners and pilot lights, shall be subjected to a burner function test following the system pressure test. A visual check for flame lift off due to excessive pressure at individual burners shall be made; a visual check for adequate flame

height shall also be made with all appliance burners in the system operating (this ensures adequate, not excessive, working pressure at each appliance).

10.3 Where a bubble leak detector is permanently fitted in the system, it shall be securely mounted in the low pressure side of the system and in the cylinder housing or cylinder locker. A pressure gauge shall be installed in the high pressure side of the system. See 4.4.

11 Electrical devices for ignition sources

There shall be no potential sources of ignition in LPG cylinder lockers or housings. If electrical devices are located in such places, the equipment shall be ignition protected in accordance with ISO 8846.

12 Owners manual

The craft manufacturer shall provide an owner's manual conforming to ISO 10240 in language acceptable in the country of use, and shall include with it the user instructions supplied by the manufacturers of equipment and appliances. Requirements and guidance for the contents of the owner's manual are given in Annex C.

13 Ducts and flues for air intake and combustion product discharge

13.1 Flue components, including ductwork and terminals, shall be installed in accordance with the manufacturer's instructions for small craft installations.

13.2 Flues shall be routed and sized to ensure complete discharge of the products of combustion outside the craft, including any areas which can be enclosed by canopies, and so as not to be obstructed by an accumulation of water.

13.3 The flue system and air intake duct system shall each be continuous and sealed to be vapour tight from the appliance to its terminal outside the craft.

13.4 Dampers (shut-off valves) shall not be installed in flue systems.

13.5 The entire flue system shall be accessible for inspection.

13.6 Flue terminals for exhaust product discharge shall not be positioned within 500 mm of a ventilator, opening port, hatch, window, refuelling fitting or fuel tank vent outlet.

13.7 Flue terminals shall be of substantial construction or provided with guards sufficient to prevent damage by accidental contact. Such guards on exhaust discharge outlets also prevent injury from contact with hot surfaces.

Annex A (informative)

Design guidelines for pressure drop due to pipe resistance

Inside diameter of hose/Outside diameter of pipe mm	Pressure drop per metre of pipe length kPa								
	Connected appliance input								
	1 kW	2 kW	3 kW	4 kW	6 kW	8 kW	10 kW	12 kW	15 kW
4	0,004	0,015	0,03	0,05	0,15	0,23	—	—	—
6	0,001	0,004	0,007	0,012	0,03	0,04	0,07	0,10	0,14
8	< 0,001	0,001	0,002	0,003	0,01	0,015	0,02	0,025	0,04
10	—	< 0,001	< 0,001	0,001	0,003	0,004	0,006	0,009	0,013
13	—	—	—	< 0,001	0,001	0,001	0,002	0,002	0,004

NOTE 1 This table is for use with propane at 3 kPa, 3,7 kPa and 5 kPa, and butane at 3 kPa and 5 kPa.

NOTE 2 Equivalent lengths of pipe for fittings are:
 — tee and elbow 0,6 m;
 — straight connector 0,3 m;
 — hose or pipe bend 0,3 m.

NOTE 3 It is advisable to minimize the volume of pipework by using the smallest pipe sizes consistent with the pressure drop requirement.

Annex B (normative)

Ventilation

The minimum required effective area of ventilation openings for accommodation spaces containing an LPG open flame (unflued) appliance (such as a cooker, stove or oven) is given by the formula in Equation (B.1):

$$A \geq 2200U + 650P \quad (\text{B.1})$$

where

A is the effective area, in square millimetres;

U is the nominal input of unflued appliances, in kilowatts;

P is the number of persons for which accommodation space is designed.

This formula applies to any space in the craft containing unflued LPG appliances that can be closed off, except by curtains with fixed ventilation openings.

The minimum effective area, *A*, of fixed ventilation is 4 000 mm².

NOTE Screening or louvres over ventilation openings reduce effective area by approximately 50 %, or more if the wire or bar size exceeds the opening dimensions between, and is accounted for.

Ventilation shall be supplied by at least two equally sized fixed openings in the compartment, with one opening as high as practicable and one as low as practicable. Both openings shall be positioned or shielded such that they cannot be inadvertently obstructed.

For additional information, see EN 721.

Annex C (normative)

Instructions to be included with the owner's manual

C.1 If an LPG system is installed in a craft, the owner's manual shall be in accordance with ISO 10240, shall provide instructions for the operation and maintenance of the system, including user instructions supplied by the manufacturers of equipment and appliances, and should contain at least the information given in this annex.

C.2 Close fuel supply line valves and cylinder valve when appliances are not in use. Close valves before refuelling and immediately in an emergency.

C.3 Be sure appliance valves are closed before opening cylinder valve.

C.4 Test the LPG system for leakage before use. Test all connections for leakage by means of the following:

- before each use, close appliance valves; open LPG cylinder valve; allow indicated gauge pressure to stabilize; close LPG cylinder valve; observe pressure gauge reading near cylinder valve for three minutes; pressure gauge reading should remain constant if no leak in the system is present; **if pressure gauge reading falls, leak is present: do not use LPG appliances;**
- routine observation of bubble leak detector (if fitted); or
- manual leak testing with foam-producing, soapy water or detergent solutions (with appliance burner valves closed and cylinder and system valves open); foam-producing solutions for leak detection on gas installations in accordance with EN 14291 meet these requirements;
- if leakage is present, close cylinder valve and have the system repaired before further use; system repairs should be made by a competent person.

CAUTION — Do not use solutions containing ammonia.

WARNING — Never use flame to check for leaks.

WARNING — Fuel burning open flame appliances consume cabin oxygen and release products of combustion into the craft. Ventilation is required when appliances are in use. Open designated vent openings while appliances are in use. Do not use the stove or oven for space heating. Never obstruct ventilation openings.

The craft manufacturer shall include information on the location and type of ventilation openings in accommodation spaces containing gas appliances.

C.5 Do not obstruct access to LPG system components in any way.

C.6 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 gas-tight lockers which are vented overboard and intended for that purpose.

C.7 Do not use LPG cylinder housings or cylinder lockers for storage of any other equipment.

WARNING — Never leave craft unattended when open flame LPG consuming appliances are in use.

WARNING — Do not smoke or use open flame when replacing LPG cylinders. Close cylinder valves on empty cylinders before disconnecting for replacement.

C.8 Hoses in the LPG system shall be inspected regularly, at least annually, and replaced if any deterioration is found.

C.9 Inspect flue pipes at least annually. Replace if deterioration or openings are found.

C.10 Do not use stove when high angles of rolling or sustained angles of heel are likely (if the craft is not equipped with a gimbaled stove).

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- [19] EN 13786, *Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures*
- [20] EN 14291, *Foam producing solutions for leak detection on gas installations*

