

Code of practice for domestic butane and propane gas-burning installations —

Part 3: Installations in boats, yachts and other vessels

ICS 47.080; 97.100.20

Confirmed December 2011

Committees responsible for this British Standard

The preparation of this Published document was entrusted to Technical Committee GME/33, Small craft, upon which the following bodies were represented:

Association of Canoe Traders
 Broads Authority
 British Marine Federation
 British Waterways Board
 Consumer Policy Committee of BSI
 CORGI — The Council for Registered Gas Installers
 DTI — Standards Policy Unit
 IMarEST — The Institute of Marine Engineering, Science and Technology
 Marine and Coastguard Agency
 National Association of Boat Owners
 Royal Yachting Association
 Wooden Boatbuilders Trade Association
 Co-opted members

The following bodies were also represented in the drafting of this standard, through panel GME/33/-/5, LPG Issues.

LP Gas Association
 National Caravan Council Limited
 Institution of Gas Engineers
 HSE — Health and Safety Executive

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 26 September 2005

© BSI 26 September 2005

The following BSI references relate to the work on this standard:
 Committee reference GME/33

Amendments issued since publication

Amd. No.	Date	Text affected

ISBN 0 580 46721 X

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Pipework materials	4
5 Selection of components	5
6 Selection of appliances	5
7 Cylinder location design considerations	6
8 High pressure stage design considerations	9
9 Low pressure stage design considerations	9
10 Flue design considerations	11
11 Ventilation design considerations	11
12 Installation of pipework	11
13 Shut-off valves	12
14 Appliances	13
15 Commissioning	15
16 Soundness	15
17 Information and instructions for safe usage	15
Annex A (normative) Existing installations	16
Annex B (normative) Area of fixed ventilation	18
Annex C (normative) Testing of low pressure stage of installation	19
Annex D (normative) Testing appliance operating pressure	23
Annex E (normative) Information for users	25
Annex F (normative) Gas leak detection	27
Bibliography	28
Figure 1 — Distance measurements from burners to combustible materials	14
Table 1 — Conversion of heat inputs (kW) to gas rate (kg/h)	6
Table 2 — Recommended off-takes for temperate climates	6
Table 3 — Pressure drop due to pipeline resistance	9
Table 4 — Equivalent lengths of pipe for fittings	10
Table C.1 — Permissible pressure drop for test with appliances connected and LPG supplied by cylinder(s) or bulk tank installation pipework	19
Table D.1 — Appliance inlet pressures	24
Table D.2 — Suitable test procedure (taken from EN 12864:2001)	24

Foreword

This Published Document has been prepared jointly by GME/33 and GSE/31. It recommends good practice for installation of liquefied petroleum gas (LPG) appliances in boats, yachts and other vessels.

This Published Document replaces BS 5482-3:1999, which is withdrawn. As a code of practice this Published Document takes the form of guidance and recommendations.

For installations constructed to BS EN ISO 10239, *Small craft — Liquefied Petroleum Gas (LPG) systems*, that standard should be referred to for examination of the adequacy of construction.

Attention is drawn to the Gas Safety (Installation and Use) Regulations [1], [2]. Any work on gas appliances, including their installation, that falls within the scope of the Gas Safety (Installation and Use) Regulations (i.e. most work outside of factories) must be carried out by a business that is a “member of a class of persons” approved for the time being by the Health and Safety Executive (HSE). At the time of publication, the body with HSE approval to operate and maintain a register of businesses who are “members of a class of persons” is the Council for Registered Gas Installers (CORGI). Thus it is essential that all business or self-employed gas fitters be registered with CORGI.

Guidance on the individual competency required for gas work is given in the Health and Safety Commission’s Approved Code of Practice (ACOP) [3].

Persons deemed competent to carry out gas work are those who hold a current certificate of competence in the type of activity to be conducted, issued under the ACOP arrangements, or by a certification body accredited by the United Kingdom Accreditation Service (UKAS).

As a code of practice, this Published Document takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

This Published Document calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 28, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

1 Scope

This part of this Published Document covers gas burning installations in boats, yachts and other vessels¹⁾ of up to 24 m in length, using liquefied petroleum gas (LPG) from either cylinders stowed on board or, in the situation of a fixed shore bulk supply, the onboard aspects of the gas system, operating at 28–30 mbar²⁾ for commercial butane and 37 mbar for commercial propane. It does not cover use of LPG for propulsion of vessels for which guidance is given in LPGA Code of Practice No. 18 [4].

It gives guidance on selection of materials, appliances and components, design considerations, installation requirements, inspection, and testing, and preparing instructions for the user. This part of this Published Document gives recommendations for selection and maintenance of room sealed appliances and non-room sealed cooking appliances. It is intended for new installations, but recommendations for existing installations are given in Annex A.

This Published Document does not cover installation of bulk supplies of LPG or portable LPG-burning appliances.

This Published Document does not cover appliances with directly attached gas cylinders such as portable self-contained camping stoves or portable gas lamps and does not cover the installation of LPG generators.

NOTE Further information can be found in Document IGE/UP/8 [5].

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this Published Document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 476-7, *Fire tests on building materials and structures — Part 7: Method of test to determine the classification of the surface spread of flame of products*.

BS 476-20, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles)*.

BS 669 (both parts), *Flexible hoses, end fittings and sockets for gas burning appliances*.

BS 1179:1967, *Glossary of terms used in the gas industry*.

BS 1179-6:1980, *Glossary of terms used in the gas industry — Part 6: Combustion and utilization including installation at consumers' premises*.

BS 1552, *Specification for open bottomed taper plug valves for 1st, 2nd and 3rd family gases up to 200 mbar*.

BS 1723, *Specification for brazing*.

BS 3016, *Specification for pressure regulators and automatic changeover devices for liquefied petroleum gases*.

BS 3212, *Specification for flexible rubber tubing, rubber hose and rubber hose assemblies for use in LPG vapour phase and LPG/air installations*.

BS 5258-11, *Safety of domestic gas appliances — Part 11: Flueless catalytic combustion heaters (3rd family gases)*.

BS 6172, *Installation and maintenance of domestic gas cooking appliances (2nd and 3rd family gases) — Specification*.

BS 6362 (ISO 7598), *Specification for stainless steel tubes suitable for screwing in accordance with BS 21 "Pipe threads for tubes and fittings where pressure-tight joints are made on the threads"*.

BS 6956, *Jointing materials and compounds*.

BS 7838, *Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to 28 mm*.

¹⁾ Attention is drawn to the various Merchant Shipping Acts that apply to British registered ships.

²⁾ 1 mbar = 10² N/m² = 100 Pa.

BS EN 331, *Manually operated ball valves and closed bottom taper plug valves for gas installations in buildings.*

BS EN 449, *Specification for dedicated liquid petroleum gas appliances — Domestic flueless space heaters (including diffusive catalytic combustion heaters).*

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

BS EN 837-1, *Pressure gauges — Bourdon tube pressure gauges — Part 1: Dimensions, metrology, requirements and testing.*

BS EN 1044, *Brazing — Filler metals.*

BS EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications.*

BS EN 1254-2, *Copper and copper alloys — Plumbing fittings — Part 2: Fittings with compression ends for use with copper tubes.*

BS 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.*

BS EN 13878, *Leisure accommodation vehicles — Terms and definitions.*

BS EN 28846, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases.*

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

EN 1763, *Flexible rubber and plastics hose, tubing, nozzles and assemblies for use with propane and butane in the vapour phase — Specification.*³⁾

3 Terms and definitions

For the purposes of this part of this Published Document, the term and definitions in BS 1179:1967, BS 1179-6:1980 and BS EN 13878 apply, together with the following.

3.1

liquefied petroleum gas

LPG

mixture of light hydrocarbons, gaseous at normal temperature and pressure, maintained in the liquid state by increased pressure or lowered temperature

3.2

high pressure stage

part of an installation between the valve of the cylinder and the inlet of the pressure regulator

3.3

low pressure stage

part of an installation between the outlet of the single stage pressure regulator and the inlet of the appliance

3.4

cylinder

portable and refillable vessel of approved design, used to contain LPG under pressure

3.5

low pressure regulator

device that maintains an outlet pressure constant independent of the variations of inlet pressure and/or rate and/or temperature within defined limits

³⁾ In preparation.

3.6**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

3.7**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

3.8**flame supervision device**

device that prevents gas flowing to the burner, ignition burner, or pilot light if there is no flame at the burner or pilot light

3.9**room sealed appliance**

appliance with a system in which incoming combustion air and outgoing combustion products pass through sealed ductwork connected to an enclosed combustion chamber and terminating outside the vessel

3.10**accessible**

capable of being reached for inspection, removal or maintenance, without removal of a permanent vessel structure

NOTE Hatches are not included as permanent vessel structures, even if tools are required to open them.

3.11**readily accessible**

capable of being reached for operation, inspection or maintenance, without removal of a vessel structure, or use of tools or keys, or removal of any item of portable equipment stowed in a place intended for storage of portable equipment (e.g. lockers, drawers or shelves)

3.12**main shut-off valve**

valve for isolating an LPG system from a high pressure stage supply

3.13**ventilator**

device that allows air to pass into and out of an accommodation space

3.14**appliance connector**

pipe or hose connecting an appliance isolation valve and the appliance inlet connection

3.15**supply control valve**

isolating valve immediately upstream of the test section during the soundness test. This may be the cylinder or tank outlet valve or an intermediate valve depending on the section of pipework to be tested

3.16**burner tap**

user-operated tap

NOTE For example, a cooker hot-plate tap.

3.17**let-by**

internal gas leakage past a shut-off valve seat when fully closed

3.18**bourdon gauge**

dial-type pressure gauge conforming to BS EN 837-1

3.19

appliance isolation valve

valve fitted in the supply pipe to an individual appliance to allow isolation in emergency or for servicing purposes

3.20

intermediate pressure stage

part of the installation between a first stage regulator and a second stage regulator

3.21

closed-flue appliance

appliance where the flue is closed from a room or internal space due to the absence of a draught diverter, flue break and any draught break within the flue

3.22

conventionally flued instantaneous water heater

water heater of the B_{11BS} type

NOTE A type B_{11BS} type is a type B₁₁ appliance fitted with a combustion products discharge safety device. A type B₁₁ is a natural draught type B₁ appliance. A type B₁ is a type B appliance incorporating a draught diverter. A type B is an appliance intended to be connected to a flue that evacuates the products of combustion to the outside of the room containing the appliance. The combustion air is drawn directly from the room in which the appliance is installed.

3.23

combustion products discharge safety device

device that causes at least safety shutdown of the main burner, when there is an unacceptable spillage of combustion products from the draught diverter of type B_{11BS} water heaters

4 Pipework materials

The following materials should be used for installation pipework:

- a) seamless copper tube conforming to BS EN 1057 with fittings in accordance with **5.3**;
- b) stainless steel tube conforming to BS 6362. Corrugated stainless steel pipes should conform to BS 7838. Appropriate compression or screwed fittings should be used;
- c) copper nickel alloy, of a grade suitable for use with LPG and a marine environment, and appropriate compression or screwed fittings.

The following materials should not be used for installation pipework, for the reasons given:

- a) aluminium (corrosion, low melting point, vibration);
- b) lead (creep);
- c) brass tubing (season cracking);
- d) steel tubing (corrosion);
- e) plastics (low melting point, low-temperature embrittlement).

Tubing of the type fabricated from sheet steel, coated internally and externally and wrapped, is subject to atmospheric corrosion and should not be used.

Care should be taken to ensure that PVC does not come into contact with stainless steel, owing to the risk of corrosion.

5 Selection of components

5.1 General

Components should be suitable for use with LPG and a marine environment.

5.2 Valves

Ball valves should conform to BS EN 331.

Tapered plug cocks should conform to BS 1552, and should be spring-loaded and fitted with an operating handle designed to indicate clearly whether the cock is in the open or closed position. Valves should be clearly marked with direction of rotation to open or close, or open and closed positions should be obvious by design.

A cock at floor level should be of either the drop fan or the loose key type or so positioned to prevent inadvertent operation.

Needle valves and gate valves should not be used as isolating valves.

Lubricants used in valves upstream of appliances should be of a type suitable for use with LPG, e.g. lubricants having a 25 % molybdenum disulfide base.

5.3 Joints

Compression fittings should be made of copper or copper alloy conforming to BS EN 1254-2. Annealed olives should be used.

Stainless steel rings should be used on stainless steel piping.

Brazed connections made in accordance with BS 1723 using BS EN 1044 filler metals. The melting point of materials at hard soldered or brazed connections should not be less than 450 °C.

Push-fit quick release hose fittings conforming to BS 669 should be installed in accordance with BS 6172.

5.4 Joint and thread sealing

Washers or gaskets should be of a material suitable for use with LPG, durable, robust, and gas tight. Fibre washers and hemp should not be used.

PTFE tape should conform to BS EN 751-3 and should be used in accordance with the manufacturer's recommendations. (PTFE tape conforming to BS 7786 should not be used on pipework.)

Jointing compounds should conform to BS 6956 and should only be applied to tapered male threads of components.

6 Selection of appliances

6.1 General

Appliances should be recommended by the manufacturers as suitable for use in a marine environment. Appliances should be room sealed (with the exception of cooking appliances and conventionally flued instantaneous water heaters used for replacement purposes).

Only appliances that carry an appropriate CE mark should be installed.

6.2 Flame supervision devices

Appliance burners, ignition burners and pilot lights should be fitted with flame supervision devices that completely close the LPG supply to the burner to which it is fitted.

7 Cylinder location design considerations

7.1 Layout of supply system

Layout should be such that the length of pipe from the inlet of the gas supply to the highest rated appliances is as short as possible and all pipe runs, particularly at intermediate pressure stage, should be as short as practicable.

NOTE 1 Further information is given in the LPGA Code of Practice 22 [6].

NOTE 2 Health and Safety Executive recommendations indicate that under no circumstances should the temperature of the cylinder exceed 45 °C.

7.2 Cylinder supply

When designing a cylinder installation, the installer should ensure that the cylinder(s) selected and other supply equipment (e.g. the regulator) are of sufficient capacity to ensure safe and satisfactory operation of all appliances simultaneously.

NOTE Gas consumption details for each installed appliance can be found on the appliance data badge.

Table 1 provides guidance on conversion from heat input to gas rates.

Table 1 — Conversion of heat inputs (kW) to gas rate (kg/h)

kW	0	1	2	3	4	5	6	7	8	9
0	0.00	0.07	0.15	0.22	0.29	0.37	0.44	0.51	0.58	0.66
10	0.73	0.80	0.88	0.95	1.02	1.10	1.17	1.24	1.31	1.39
20	1.46	1.53	1.61	1.68	1.75	1.83	1.90	1.97	2.04	2.12
30	2.19	2.26	2.34	2.41	2.48	2.56	2.63	2.70	2.77	2.85
40	2.92	2.99	3.07	3.14	3.21	3.29	3.36	3.43	3.50	3.58
50	3.65	3.72	3.80	3.87	3.94	4.02	4.09	4.16	4.23	4.31
60	4.38	4.45	4.53	4.60	4.67	4.75	4.82	4.89	4.96	5.04
70	5.11	5.18	5.26	5.33	5.40	5.48	5.55	5.62	5.69	5.77
80	5.84	5.91	5.99	6.06	6.13	6.21	6.28	6.35	6.42	6.50
90	6.57	6.64	6.72	6.79	6.86	6.94	7.01	7.08	7.15	7.23

NOTE Due to the very similar gas rates of butane and propane and for practical purposes, this table covers both gases.

For a continuous supply, multiple cylinders may be installed. These may be installed in pairs or in banks of cylinders, interconnected via an automatic changeover device that switches gas supply as cylinders empty. Alternatively, they may be directly connected through wall block arrangements.

Table 2 provides guidance on recommended off-takes for temperate climates

Table 2 — Recommended off-takes for temperate climates

Butane		Propane	
Cylinder size kg	Off-take kg/h	Cylinder size kg	Off-take kg/h
15	0.696	13	1.054
—	—	19	1.319
—	—	47	2.373

For butane cylinders, satisfactory service might not be obtained at a temperature of less than 10 °C; the most suitable temperature range is from 13 °C to 30 °C. For temperatures less than 13 °C, the use of propane should be considered.

EXAMPLE

Calculate the total heat input in kilowatts of all gas appliances to be supplied by cylinder(s) as follows.

Cooker	14.0 kW
Space heater	5.5 kW
Water heater	13.5 kW
Total	<u>33.0kW</u>

NOTE For cookers, 70 % of the maximum gas rate may be used. In the example above, the cooker input is 20 kW. Based on 70 %, this would equate to 14 kW for this example.

Therefore the gas rate (deduced from Table 1) would be 2.41 kg/h.

To calculate the number of cylinders required, divide 2.41 kg/h by the cylinder off-take rates given in Table 2:

a) for butane:

$2.41 \text{ kg/h} \div 0.696 \text{ (off-take rate for a 15 kg butane cylinder)} = 3.46$.

Therefore this installation would require $4 \times 15 \text{ kg butane cylinders}$;

b) for propane:

$2.41 \text{ kg/h} \div 1.319 \text{ (off-take rate for a 19 kg propane cylinder)} = 1.83$.

Therefore this installation would require $2 \times 19 \text{ kg propane cylinders}$.

7.3 Cylinder location

Cylinders (full or empty, stored or in use) should be:

- a) secured on the open deck, on cabin tops, or outside cockpits, so that any leakage flows overboard; or
- b) in a cylinder locker with a drain that directs any leakage outside the hull, in any condition of heel and loading. Cylinders, when in position, should not obstruct the drain.

NOTE Cylinders in self-draining cockpits may be secured in a cylinder housing if it is LPG tight to the interior of the vessel.

Cylinders should be stowed as follows.

- a) The possibility of cylinders damaging low pressure regulators or pipework should be minimized.
- b) Cylinders and cylinder lockers or housings should not form an obstruction.
- c) Cylinders should be upright with the valve uppermost, and secured so that damage cannot occur to the cylinders, regulators, hoses, or pipework.
- d) Cylinders should be accessible and removable in an emergency.
- e) Cylinders should be secured so that damage cannot occur to the cylinders, regulators, hoses, or pipework.

7.4 Stowage on open decks and cabin tops or outside cockpits

Cylinders on open decks or cabin tops or outside cockpits should be stowed as follows.

- a) Cylinders, low pressure regulators and associated equipment should be stowed so that any leaked LPG flows overboard.
- b) Cylinders, low pressure regulators and associated equipment should be stowed at least one metre from hatches and other openings to the interior of the vessel and possible sources of ignition.

NOTE Cylinders, low pressure regulators and associated equipment may be stowed in a cylinder locker or cylinder housing on open decks and cabin tops or outside cockpits, if the cylinder locker or cylinder housing conforms to a) and b).