

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

Part 1: Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper

ICS 91.140.40; 97.100.20

Confirmed September 2010

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee GSE/31, Installations using Neat LPG, upon which the following bodies were represented:

- British Marine Federation
- British Waterways Board
- Caravan Club
- Consumer Policy Committee of BSI
- CORGI
- DTI Standards and Technical Regulations Directorate
- HSE
- Institution of Gas Engineers
- LP Gas Association
- National Caravan Council Limited
- Society of British Gas Industries
- Society of Motor Manufacturers and Traders Limited

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 20 January 2005
© BSI 20 January 2005
First published as CP 339 Part 1 November 1956 and as CP 338 October 1957
Second edition as BS 5482 part 1 January 1979
Third edition January 1994
Fourth edition November 2004

The following BSI references relate to the work on this British Standard:
Committee reference GSE/31
Draft for Comment 00/716887 DC

Amendments issued since publication

Amd. No	Date	Comments

Contents

Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Normative references	1
3 Terms and definitions	3
4 Exchange of information and installation planning	6
5 Materials	6
6 Valves	7
7 Regulators	7
8 Joints	7
9 Corrosion	8
10 Selection of appliances	9
11 LPG supply arrangements	10
12 Installation	18
13 Inspection, testing and user instructions	35
Annex A (normative) Gas soundness testing of LPG service pipework, installation pipework, and appliances	36
Annex B (informative) Guide for sizing gas supply pipes	45
Annex C (informative) Model emergency action notice or leaflet for users of LPG	48
Bibliography	49
Figure 1 — Thread wrapping method	8
Figure 2 — Cylinder Location	12
Figure 3 — Typical 4 × 47 kg cylinder installation	14
Figure 4 — Use of temporary electrical continuity bonding connector	19
Figure 5 — Pipe joists	20
Figure 6 — Typical examples of buried pipes	21
Figure 7 — Typical examples of pipes in masonry and timber frame walls	23
Figure 8 — Typical installation pipework in multi-storey buildings containing flats or maisonettes	29
Figure 9 — Position of mains equipotential bond (electrical cross-bonding)	33
Figure A.1 — Butane cylinder installations	43
Figure A.2 — Propane cylinder installations	44
Figure A.3 — Multiple propane cylinder installations	44
Figure A.4 — Bulk tank installations (service pipework at low pressure)	44
Figure A.5 — Bulk tank installations (service pipework at intermediate pressure)	45
Figure B.1 — Example calculation	46
Table 1 — Conversion of heat inputs (kW) to gravimetric calorific value (kg/h)	10
Table 2 — Recommended off-takes for temperature climates	10
Table 3 — Pipe sizing	16
Table 4 — Equivalent lengths of pipe for fittings	17
Table 5 — Free area of ventilation openings	27
Table 6 — Maximum interval between pipe supports	31
Table A.1 — Permissible pressure drop for test with appliances connected and LPG supplied by cylinder(s) or bulk tank installation pipework	43
Table A.2 — Permissible pressure drop for test with appliances connected and propane supplied from a bulk tank	43
Table B.1 — Typical appliance gas rates	46
Table B.2 — Sizing results	47

Foreword

This Part of BS 5482 has been prepared by Technical Committee GSE/31. It supersedes BS 5482-1:1994 which is withdrawn, and partially supersedes BS 5482-2:1977. It has been revised to take into account current technology and practice.

Legislation requires persons carrying out work to have the required competence. The Gas Safety (Installation and Use) Regulations [1], [2] require any “work” on gas appliances, including their installation, that falls within their scope (i.e. most work outside of factories) to be carried out by a business which is a “member of a class of persons” approved for the time being by the Health and Safety Executive (HSE).

NOTE 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 should 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].

As a code of practice, this British Standard 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 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. Attention is drawn to the following statutory regulations:

The Health and Safety at Work Act 1974.

Gas Safety (Installation and Use) Regulations 1998 (SI 2451) [1].

Gas Safety (Installation and Use) Regulations (Northern Ireland) 1997 (SI 194) [2].

Building Regulations 1991 (SI 2768) (as amended) [4].

Building Standards (Scotland) Regulations 1990 (SI 2179) (as amended) [5].

Building Regulations (Northern Ireland) 1990 (SR 59) (as amended) [6].

NOTE [4], [5] and [6] do not apply to residential park homes.

Summary of pages

This document consists of a front cover, an inside front cover, pages i and ii, pages 1 to 49 and a back cover.

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

1 Scope

This Part of BS 5482 gives guidance and recommendations for the installation of liquefied petroleum gas (LPG) supply systems at permanent dwellings, including residential park homes, and small commercial premises, with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper. It applies to systems using either commercial propane from cylinders or bulk supply at a pressure of 37 mbar, or commercial butane from cylinders at a pressure of 28 mbar. It makes recommendations on the selection of materials and components, on design considerations, on installation, on inspection and testing and on user instructions.

NOTE 1 Gas storage and distribution systems for multiple consumers are outside the scope of this standard.

This standard does not cover the installation requirements of bulk tanks supplying LPG, for which guidance is given in LPGA Code of Practice 1, Parts 1, 2, and 4.[7].

Appliances incorporating their own gas supply, such as mobile heaters, are not considered to be part of the installation and are thus outside the scope of this standard.

NOTE 2 It is recognized that this standard may be referred to for LPG installations other than those concerned with domestic systems at permanent dwellings and residential park homes. In these instances it has to be borne in mind that other codes of practice, standards and regulations may apply.

This standard does not cover leisure accommodation vehicles (see BS EN 1949).

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.

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)*.

BS 143 and 1256, *Threaded pipe fittings in malleable cast iron and cast copper alloy*.

BS 476 (all parts), *Fire tests on building materials and structures*.

BS 669 (all 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 1387, *Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads*.

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

BS 1710, *Specification for identification of pipelines and services*.

BS 1723, *Brazing*.

BS 3016:1989, *Specification for pressure regulators and automatic changeover devices for liquefied petroleum gases*.

BS 3212:1991, *Specification for flexible rubber tubing, rubber hose and rubber hose assemblies for use in LPG vapour phase and LPG/air installations*.

BS 3605, *Austenitic stainless steel pipes and tubes for pressure purposes*.

BS 3632, *Specification for residential park homes*.

BS 5114, *Specification for performance requirements for joints and compression fittings for use with polyethylene pipes*.

BS 5292, *Specification for jointing materials and compounds for installations using water, low-pressure steam or 1st, 2nd and 3rd family gases*.

BS 5440-1, *Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) — Part 1: Specification for installation and maintenance of flues*.

BS 5440-2, *Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) — Part 2: Specification for installation and maintenance of ventilation for gas appliances.*

BS 5449, *Specification for forced circulation hot water central heating systems for domestic premises.*

BS 5546, *Specification for installation of hot water supplies for domestic purposes, using gas-fired appliances of rated input not exceeding 70 kW.*

BS 5864, *Specification for installation in domestic premises of gas-fired ducted-air heaters of rated input not exceeding 60 kW.*

BS 5871-1, *Specification for installation of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances — Part 1: Gas fires, convector heaters and fire/back boilers (1st, 2nd and 3rd family gases).*

BS 5871-2, *Specification for installation of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances — Part 2: Inset live fuel effect gas fires of heat input not exceeding 15 kW (2nd and 3rd family gases).*

BS 5871-3, *Specification for installation of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances — Part 3: Decorative fuel effect gas appliances of heat input not exceeding 15 kW (2nd and 3rd family gases).*

BS 6004:2001, *Electric cables — PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring.*

BS 6007, *Electric cables — Single core unsheathed heat resisting cables for voltages up to and including 450/750 V, for internal wiring.*

BS 6172, *Specification for installation of domestic gas cooking appliances (1st, 2nd and 3rd family gases).*

BS 6173, *Specification for installation of gas-fired catering appliances for use in all types of catering establishments (2nd and 3rd family gases).*

BS 6231, *Specification for PVC-insulated cables for switchgear and controlgear wiring.*

BS 6400, *Specification for installation of domestic sized gas meters (2nd and 3rd family gases).*

BS 6644, *Specification for installation of gas-fired hot water boilers of rated inputs between 60 kW and 2 MW (2nd and 3rd family gases).*

BS 6700, *Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.*

BS 6798, *Specification for installation of gas-fired boilers of rated input not exceeding 70 kW net.*

BS 6956, *Jointing materials and compounds.*

BS 7281, *Specification for polyethylene pipes for the supply of gaseous fuels.*

BS 7336, *Specification for polyethylene fusion fittings with integral heating element(s) for use with polyethylene pipes for the conveyance of gaseous fuels.*

BS 7624, *Specification for installation of domestic direct gas-fired tumble dryers of up to 3kW heat input (2nd and 3rd family gases).*

BS 7671:2001, *Requirements for electrical installations — IEE Wiring Regulations. Sixteenth edition.*

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

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

BS EN 751, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water.*

BS EN 837-1:1998, *Pressure gauges — Bourdon tube pressure gauges — Part 1: Dimensions, metrology, requirements and testing.*

BS EN 1044, *Brazing — Filler metals.*

BS EN 1254-1, *Copper and copper alloys — Plumbing fittings — Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes.*

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

BS EN 10216, *Seamless steel tubes for pressure purposes.*

BS EN 10217, *Welded steel tubes for pressure purposes.*

BS EN 10242, *Threaded pipe fittings in malleable cast iron.*

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 29453, *Soft solder alloys — Chemical compositions and forms.*

BS EN ISO 228 (all parts), *Pipe threads where pressure-tight joints are not made on the threads.*

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 1179:1967, BS 1179-6 1980, BS EN 27418:1994, BS 5440-1 and 2, BS 3632 and the following apply:

3.1

appliance isolation valve

manual shut-off valve at the gas supply entry to the appliance

3.2

Bourdon gauge

dial-type pressure gauge conforming to BS EN 837-1:1998

3.3

bulk tank

permanently-installed vessel for the storage of LPG under pressure which is filled in situ

3.4

burner tap

user-operated tap, e.g. a cooker hot-plate tap

3.5

compartment

building or part of a building comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building

NOTE A roof space above the top storey of a compartment is included in that compartment.

3.6

cylinder

portable and refillable vessel containing LPG under pressure

3.7

duct

purpose-designed enclosure to contain gas pipes

3.8

emergency control

the valve at the nearest point of entry of the gas supply to the premises as required by the Gas Safety (Installation and Use) Regulations [1], [2]

3.9

fire-resisting

satisfying, for a stated period of time, the appropriate criteria specified in the relevant part of BS 476

3.10

gas detector

hand-held detector calibrated for LPG and provided with a probe to search for gas leakage from pipework joints

3.11

high pressure stage

that part of the installation between the valve of the cylinder/tank and the inlet of the high pressure (first stage) regulator

3.12

installation pipework

pipework from the emergency control up to and including any shut-off device, e.g. appliance isolation valve at the inlet to the gas appliances as defined in the Gas Safety (Installation and Use) Regulations [1], [2]

3.13

intermediate pressure stage

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

3.14

leisure accommodation vehicle

unit of living accommodation for temporary or seasonal occupation that might meet the requirements of the Road Vehicles (Construction and Use) Regulations

NOTE This includes touring caravans, motor caravans and caravan holiday homes.

3.15

let-by

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

3.16

liquefied petroleum gas

LPG

commercial butane or commercial propane in accordance with BS 4250

3.17

low pressure regulator

apparatus for automatically maintaining a constant gas outlet pressure at the level recommended for the appliance(s) in use

3.18

low pressure stage

that part of the installation between the outlet of the single stage pressure regulator (or second stage regulator when an intermediate stage is used) and the inlet of the appliance

3.19

over pressure shut-off

OPSO

manually resettable device that closes to prevent the flow of gas when the pressure on the downstream side of the regulating member rises to a predetermined value

NOTE This device is normally an integral part of the regulator.

3.20

permanent dwelling

structure of a permanent nature, to which appropriate building regulations apply and which is used primarily for domestic purposes

3.21

pressure regulator

apparatus for automatically maintaining a constant gas outlet pressure

3.22**pressure relief valve**

automatic valve incorporated to protect a cylinder or system against excessive pressure

NOTE It will vent to atmosphere when a predetermined maximum pressure is attained.

3.23**primary meter**

meter nearest to and downstream of a service pipe for ascertaining the quantity of gas supplied through that pipe

3.24**protected shaft**

shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed within a fire-resisting construction

3.25**residential park home**

caravan designed for permanent residential accommodation that conforms to BS 3632 but does not meet all of the requirements of the Road Vehicles (Construction and Use) Regulations

3.26**service pipework**

external pipework from a bulk tank to, and including, the emergency control at the premises as defined in the Gas Safety (Installation and Use) Regulations [1], [2]

3.27**sleeve**

tubular case inserted in a prepared hole in a structure for the reception of an installation pipe

3.28**supplier**

person who provides a supply of LPG to a consumer either by means of the filling or refilling of a storage vessel designed to be filled or refilled, or a person who provides gas in refillable cylinders for use by a consumer

NOTE The meaning of supplier depends on the circumstances. Where LPG is supplied directly to a consumer, the supplier is the gas company whose gas is used to fill the tank or cylinders concerned. Where gas is supplied to an intermediate person, e.g. "landlord", who provides a gas supply on to "tenant" consumers, allocation of "supplier" duties is as follows:

- a) gas supplied by filling or refilling a storage vessel. Where the gas is to be provided by a landlord for the use of tenant(s) in a building or part of a building, the gas company is the supplier. However, where the gas is provided for use by consumers in premises other than buildings, such as caravans, the landlord (e.g. caravan park operator) is the supplier.
- b) gas supplied in cylinders. The gas company attracts supplier-related duties in all cases, but where the landlord provides the gas for use in premises other than buildings, e.g. caravans, mobile homes, residential park homes, duties are shared between the gas company and the landlord.

3.29**supply control valve**

isolating valve immediately upstream of the test section during the soundness test

NOTE This may be the cylinder or tank outlet valve or an intermediate valve depending on the section of pipework to be tested

3.30**"U" gauge**

water manometer

3.31**under pressure shut-off****UPS0**

manually resettable device that closes to prevent the flow of gas when the pressure on the downstream side of the regulating member falls to a predetermined value

NOTE This device is normally an integral part of the regulator.

4 Exchange of information and installation planning

4.1 Permanent dwellings

4.1.1 At the initial stages of building design and planning the interested parties should verify that the installation pipes will be adequate for both immediate and probable future requirements. A time schedule for fixing the installation pipes should be agreed as early as possible and any subsequent changes be notified to interested parties at the earliest opportunity.

4.1.2 Information regarding the routing of installation pipes and positions of valves and installation points to serve the appliances should be made available by the installer to those concerned as early as possible by means of drawings, specifications and through consultation.

The drawings should also include:

- a) the position of ducts and channels when installation pipes are to be concealed;
- b) special requirements of a precautionary nature, e.g. limitations on proximity to other services;
- c) sizes, materials and position of all installation pipes and valves.

4.1.3 Any installation pipe fitted as erection of a building progresses, and which will subsequently be inaccessible, should be tested for soundness before being buried, covered or wrapped.

5 Materials

5.1 Pipes and fittings

5.1.1 *General*

Materials used for gas installation pipes and fittings should conform to the British Standards listed in **5.1.2** to **5.1.5**.

NOTE When selecting materials for use as installation pipes, consideration should be given to strength, appearance, cost and to the need for protection against corrosion (see Clause 9).

5.1.2 *Steel*

Steel pipes and fittings should conform to BS 1387 (medium or heavy grade), BS EN 10216-1, BS EN 10217-1, BS EN 10216-2 and BS EN 10217-2. Rigid stainless steel pipes should conform to BS 6362. Corrugated stainless steel pipes should conform to BS 7838.

NOTE Medium grade tubes conforming to BS 1387 will normally suffice but for external below-ground pipework the use of the heavy grade should be considered.

5.1.3 *Malleable iron*

Malleable iron fittings should conform to BS 143, BS 1256 and BS EN 10242.

5.1.4 *Copper*

Copper tube should conform to BS EN 1057.

Copper capillary and compression fittings should conform to BS EN 1254-1 and BS EN 1254-2.

Brazed joints should be made in accordance with BS 1723 using BS EN 1044 filler metals. Soft solder should conform to BS EN 29453.

5.1.5 *Medium Density Polyethylene (MDPE) Pipe*

MDPE pipes should conform to BS 7281.

MDPE fittings should conform to BS 5114:1975 or BS 7336, as appropriate.

MDPE installation pipework and fittings should only be used for external installation pipework.

NOTE The use of polyethylene installation pipework and fittings may be beneficial where it is necessary for installation pipework to be run underground externally from one location to another.

5.2 Thread sealing

Thread sealing materials should conform to BS EN 751, BS 6956 or BS 5292:1980, as appropriate.

NOTE BS 7786 provides general requirements for unsintered PTFE tape.

6 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.

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.

7 Regulators

High pressure first stage, low pressure second stage and automatic changeover regulators should conform to BS 3016:1989. Regulators supplied at vapour pressure by a single cylinder should conform to BS EN 12864:2001.

8 Joints

8.1 Capillary fittings

Capillary fittings for copper tube should conform to BS EN 1254-1. Pipe ends should be square cut and deburred. Finished joints should be visually examined to confirm that the solder has run. Any flux used should only remain active during the heating process.

NOTE Copper pipes may be jointed without conventional fittings by the use of purpose-made tools that form the pipe ends, in accordance with BS EN 1254-1 and BS EN 1254-2. Attention is drawn to the need to remove any remaining flux after the joint is made.

8.2 Compression fittings

Compression fittings should conform to BS EN 1254-2 and should only be used where they will be readily accessible and will allow the nut to be tightened to make a sound joint.

NOTE 1 Pipes under floor or in ducts without removable covers are not considered to be readily accessible.

Annealed olives should be used.

Type A (non-manipulative) fittings conforming to BS EN 1254-1 and 2 should not be used on annealed copper tube unless the copper tube manufacturer is consulted and jointing is carried out in accordance with the manufacturer's recommendations.

The ends of any pipe to be joined by a compression fitting should be square cut and deburred.

8.3 Push-fit fittings

With the exception of fittings conforming to BS 669 installed in accordance with BS 6172, BS 6173 or BS 7624, quick-release fittings should not be used for gas installations. With the exception of fittings conforming to BS 7838 for use with corrugated stainless steel semi-rigid pipe, push-type fittings should not be used for gas installations.

8.4 Union joints

Union joints should be located in readily accessible positions and should be of the ground-faced or compression type.

NOTE Pipes under floor or in ducts without removable covers are not considered to be readily accessible.

8.5 Screwed joints

All malleable cast iron and cast copper alloy fittings used in screwed joints should conform to BS 143 and BS 1256. Threads on long screws (see BS 21) should be parallel, conforming to BS 21. Threads on other fittings, except those conforming to BS EN 1254-1 and BS EN 1254-2 or to BS EN ISO 228, should be in accordance with BS 21.

All threads should be clean prior to the application of any thread sealing material.

Hemp should not be used on any threaded joint except in conjunction with thread sealing compounds for long screw back-nut seals.

Malleable cast iron fittings are only suitable for intermediate and low pressure stage installations.

When jointing paste is used it should only be applied to the external threads and any excess paste should be removed on completion of the joint. Jointing compound should not be used in conjunction with PTFE tape.

PTFE tape should be wound with a 50 % overlap starting from the thread runout in a direction counter to the thread form (see Figure 1). Attention is drawn to the need to remove any cutting oil from the inside of the pipe.

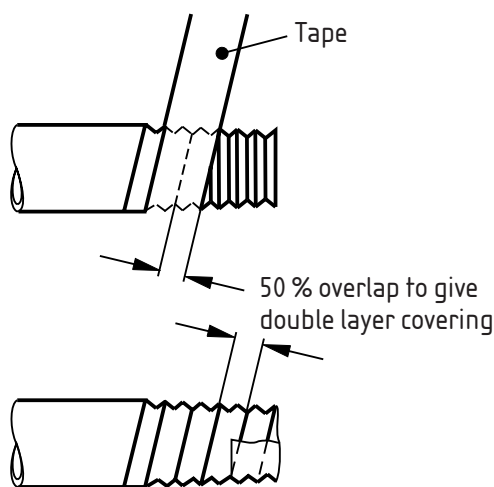


Figure 1 — Thread wrapping method

9 Corrosion

9.1 General

9.1.1 A gas pipe or pipe fitting should not be installed in a position where it is likely to be exposed to a corrosive environment. Gas pipes or fittings that are considered to be at risk should either be manufactured from materials that are inherently resistant to corrosion or should be protected against corrosion.

Factory-finished protected pipe should be used. Where it is not practicable to use or obtain such pipe, protection should be applied after testing in accordance with **9.1.3**.

NOTE 1 Factory-finished protection may take the form of sheathing, wrapping, dipping, galvanizing or painting.

Care should be taken to avoid damaging protective coatings during storage, when bending and when passing through holes and sleeves. Protection of joints requires special attention; exposed threads are particularly vulnerable to corrosion.

NOTE 2 Typical site protection is the application of bituminous paints or pipe wrapping tapes of the PVC or grease-impregnated types.

Where wrapping tape is to be applied, the pipe should be clean, dry and prepared in accordance with the tape manufacturer's instructions. A minimum 50 % overlap should be used to provide a layer of at least double thickness. Where possible, wrapping should be coloured yellow ochre in accordance with BS 1710. Some pipe sheathing and wrapping tapes suffer from colour fade and surface cracking when exposed to direct sunlight. In these circumstances MDPE should not be used.

Copper pipe should not be located where it is liable to be subjected to temperatures in excess of 100 °C.

9.1.2 Pipework in fireplace openings should be factory-sheathed and/or wrapped on site.

NOTE Soot and debris can be highly corrosive.

9.1.3 Assembled pipework should be tested for soundness in accordance with Annex A before any additional protection against corrosion is applied on site.

9.2 Buried pipework

9.2.1 *Internal environment*

9.2.1.1 Pipework that is buried in a solid floor or wall should be factory-sheathed, or protected on-site by wrapping or with suitable bituminous paint protection.

The entire section of pipe and fittings to be buried should be protected. Any sheathing or wrapping should be examined for cuts or other defects and made good prior to use. Joints and fittings should be cleaned, and wrapped or painted with bituminous paint after the satisfactory completion of the soundness test (see Annex A).

Galvanized or painted pipes should not be buried without additional protection as specified in the previous paragraph.

NOTE Protective measures are applied as a precaution against electrolytic and/or chemical corrosion.

The use of factory-bonded wrapping or sheathing is recommended.

9.2.1.2 Where installation pipes are to be buried in magnesium-oxy-chloride cement or magnesite flooring, they should be of copper with a factory-bonded sheath and jointed with copper capillary fittings.

Bends and joints should be further protected by wrapping with a suitable plastic tape. All surfaces should be clean and dry before the additional protection is applied with a minimum 50 % overlap to provide at least a layer of double thickness.

9.2.2 *External environment*

9.2.3 External buried pipework should be of MDPE, or factory-sheathed copper or steel.

All metallic joints should be fully wrapped.

NOTE Further information on the correct procedures for laying buried pipes is given in LPG Code of Practice 22 [8].

9.2.4 External pipework run above-ground should be protected against corrosion by wrapping, painting or by pipe material selection.

NOTE Where copper pipes are exposed to external weather conditions they do not require further protection unless subjected to an additional corrosive source.

MDPE pipe and fittings should only be used above-ground where it is necessary to extend underground polyethylene installation pipe above ground-level for entry into a building. The polyethylene pipework above ground-level should rise vertically to the point of entry into the building, which should be as close as practicable to the external ground-level. The length of pipework above ground-level should be protected against daylight and mechanical damage.

10 Selection of appliances

NOTE The Gas Appliances (Safety) Regulations [9] require all installed appliances to carry a CE mark.

Used appliances should only be installed if they are accompanied by the full set of manufacturer's instructions and installed and commissioned as specified by these instructions.

Appliances should be installed in accordance with the manufacturer's installation instructions.

Appliances should only be converted to LPG using the appropriate conversion kit supplied by the appliance manufacturer.

11 LPG supply arrangements

11.1 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 Further information is given in LPGA Code of Practice 22 [8].

11.2 Cylinder supply

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

Table 1 provides guidance on conversion from heat input to gravimetric calorific value.

Table 1 — Conversion of heat inputs (kW) to gravimetric calorific value (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 which switches gas supply as cylinders empty.

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

NOTE 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 kW 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	33.0 kW

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:

$2.41 \div 0.696$ (off-take rate for a 15 kg butane cylinder) = 3.46 kg/h. Therefore this installation would require 4×15 kg butane cylinders;

b) for propane:

$2.41 \div 1.319$ (off-take rate for a 19 kg propane cylinder) = 1.83 kg/h. Therefore this installation would require 2×19 kg propane cylinders.

11.3 Installation design of cylinders and tanks

11.3.1 Cylinder location

11.3.1.1 General

The cylinder position should afford ease of access to facilitate changing and quick removal in case of necessity. Cylinders should be installed in the upright position with valves uppermost so that only vapour is withdrawn in use.

Cylinders should be located outside buildings in the open air and situated on firm, level ground in a well-ventilated location (see Figure 2).

The minimum dimensions for the location of cylinders from openings in the building, and untrapped drains are shown in Figure 2.

Cylinders should be located:

- a) where they remain readily accessible at all times;
- b) where they do not obstruct any means of access to or from the premises;
- c) where they are protected from accidental damage.

Where necessary, suitable protection should be provided against possible damage or interference by persons, animals or vehicles.

Cylinders should not be stored, located or used:

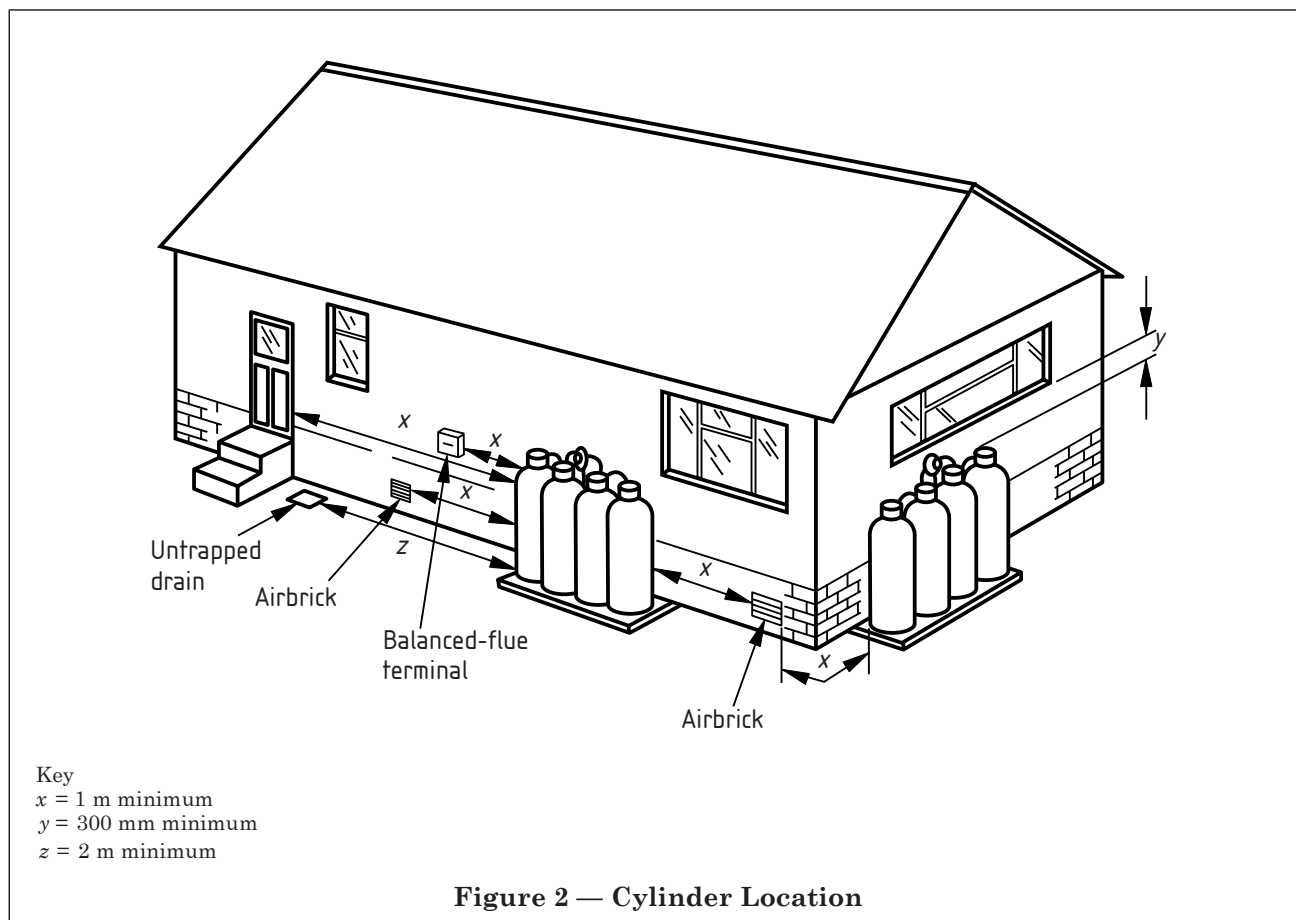
- 1) in a cellar, basement or sunken area;
- 2) less than 1 m, measured in the horizontal plane from the nearest cylinder valve, or less than 300 mm, measured vertically above the cylinder valve(s), from fixed sources of ignition, unprotected electrical equipment, excessive heat sources, readily ignitable materials etc., or apertures in the property, e.g. doors, openable windows, ventilation ducts, air bricks, flue terminals;
- 3) less than 2 m, measured in the horizontal plane, from untrapped drains or unsealed guides or openings to cellars, unless an intervening diversion wall not less than 250 mm high is provided;
- 4) within 3 m of any corrosive, toxic or oxidizing materials, unless a fire-resistant barrier is interposed.

Cylinders should be located against a wall or structure. When selecting a location for cylinders, consideration should be given to positions which are adjacent to a wall or structure with a fire resistance of not less than 30 min, or for residential park homes, the fire resistance should conform to the requirements of BS 476-7. Consideration should be given to the degree of protection necessary (if any) for environmentally exposed locations.

Associated equipment, e.g. manifolds, automatic changeover devices, pressure regulators, should be located as close as practicable to the cylinder(s).

NOTE Provided access to valves is not impaired, and the material of construction is not combustible, a hood may be provided over cylinders, for weather protection.

The area around the cylinders should be clear of litter, vegetation or other flammable material.



11.3.1.2 Cylinder enclosures

Where cylinders are installed in an enclosure, it is essential that the enclosure conforms to the following:

- the enclosure should have a fire resistance of not less than 30 min as defined in BS 476-22:1987;
- the enclosure should be of adequate size to cover the number of cylinders necessary to serve the installation and to allow for easy operation of any valve;
- the enclosure should allow access to connections and regulating devices and allow replacement of cylinders with a minimum of disturbance to the installation and ancillary equipment;
- ventilation should be provided directly to the outside above the cylinder valve, and as low as practicable to prevent accumulation of gas. For enclosures situated outside, each vent should be not less than $1/100^{\text{th}}$ of the floor area of the housing. Where an enclosure is to be provided for butane cylinders used inside residential premises, both vents may communicate either with the same room or internal space, or with the outside air at the same wall. The total area of the opening of the upper vent should be at least $1/100^{\text{th}}$ of the floor area of the housing. The lower vent should not be less than $1/100^{\text{th}}$ of the floor area of the housing when communicating direct to outside or $5/100^{\text{th}}$ of the floor area of the housing when communicating with the room or compartment.

NOTE Where the emergency control valve is located within the housing it is essential that it is readily accessible.

11.3.1.3 *Butane cylinder location*

11.3.1.3.1 *General*

Only butane cylinders should be used inside residential premises (but see 11.3.1.3.2). Butane cylinders sited inside a permanent dwelling, supplying fixed installations, should be located in a housing with a half-hour fire resistance (see 11.3.1.2.).

11.3.1.3.2 *High-rise buildings and flats*

Butane cylinders should not be used under any circumstances in high-rise unstrengthened large panel system built flats.

Butane cylinders should not be used in any premises where the use of mains gas is also prohibited.

Not more than 15 kg of butane should be stored or in use per unit dwelling.

Cylinders should be located so as not to impede any means of escape.

NOTE See BRE Report 63 [10].

Butane cylinders may be used in flats etc. of traditional construction, except for those of five or more storeys (including any basement storeys) which do not meet requirement A3 to Schedule 1 of The Building Regulations 1991 [4] or Regulation 11(2) of The Building Standards (Scotland) Regulations 1990 [5] or the Building Regulations (Northern Ireland) 1990 [6].

11.3.2 *Bulk tank location*

No person should install a gas storage vessel unless the site where it is to be installed is such as to ensure that the gas storage vessel can be used, filled or refilled without causing danger to any person.

Where a bulk tank supply is provided it should conform to LPGA Code of Practice 1, Parts 1, 2, and 4 [7]. LPG tanks should not be located indoors, within a bunded area or on a roof of a building. Location of LPG storage tanks should take into account the need for safe access for road tankers.

11.3.3 *Central storage and distribution systems for multiple consumers*

NOTE Where a bulk tank supplies more than one dwelling, attention is drawn to The Gas Safety (Installation and Use) Regulations [1], [2] and LPGA Code of Practice 25 [11].

Any LPG storage tank used to supply gas to multiple consumers should be located only at a site where the person providing the gas supply to consumers has full control over the access to the tank and associated equipment.

11.4 *Pressure reduction systems*

11.4.1 *Installation of pressure regulators*

Pressure regulators should be installed in accordance with the regulator manufacturer's instructions.

Where pressure regulators are fitted with integral pressure relief valves, they should be vented to the open air away from any source of ignition.

11.4.2 *High pressure stage design*

LPG high pressure stage vapour lines should not enter a building.

Where a cylinder supply comprises four or more cylinders connected to an automatic changeover device, an overpressure shut-off device (OPSO) meeting the requirements of BS 3016 should be fitted.

Cylinder valve connections should be compatible with the equipment to which they are connected.

Regulators and automatic changeover devices should conform to BS 3016:1989 and should be located so that the inlet to them is at or above the level of the cylinder outlet valve connection.

Vent holes in regulators should be carefully orientated or otherwise protected against the possible ingress of water or substances which could cause blockage, and also to allow for drainage.