BRITISH STANDARD

BS
5482-1:2005

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

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Caravan Club

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LP Gas Association

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Contents

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 It supersedes BS 5482-1:1994 which is withdrawn, and partially supersedes BS 5482-2:1977.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.

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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
UPSO
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 routeing 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.

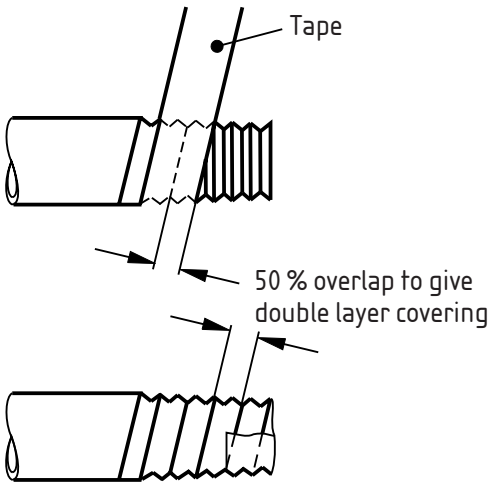


Figure 1 — Thread wrapping method

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 LPGA 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 offtakes for temperate climates.

Table 2 — Recommended off-takes for temperature 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 ÷ 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 ÷ 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;

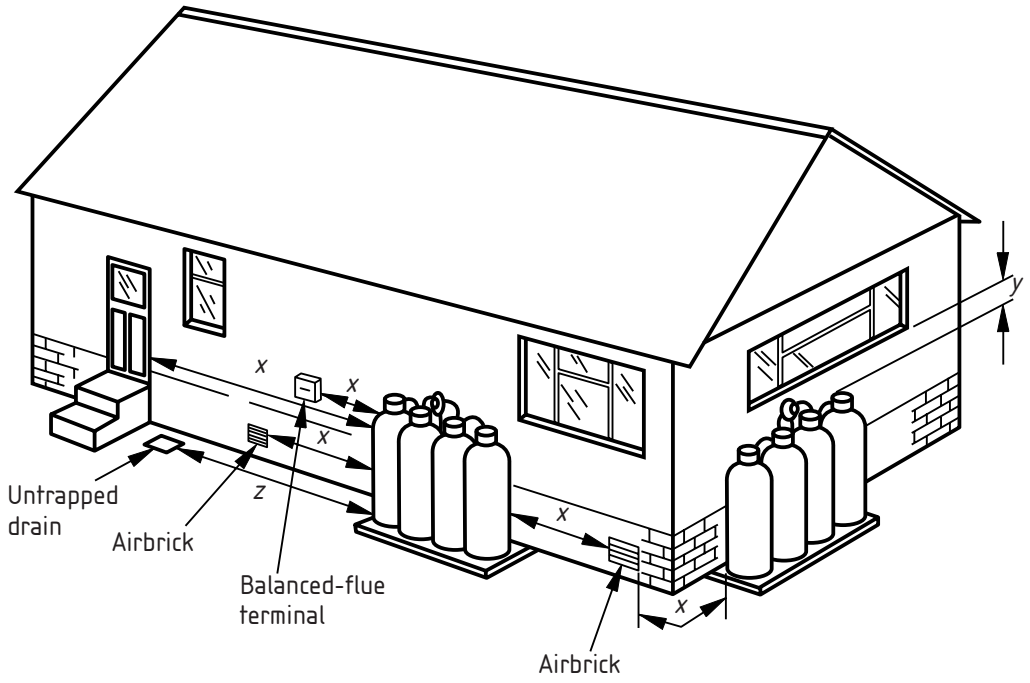
4) within 3 m of any corrosive, toxic or oxidizing materials, unless a fire-resistant barrier is interposed.

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.



Key
x = 1 m minimum
y = 300 mm minimum
z = 2 m minimum

Figure 2 — Cylinder Location

11.3.1.2 *Cylinder enclosures*

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

a) the enclosure should have a fire resistance of not less than 30 min as defined in BS 476-22:1987;

b) 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;

c) 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;

d) 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 $1/100^{th}$ 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 $1/100^{th}$ of the floor area of the housing. The lower vent should not be less than $1/100^{th}$ of the floor area of the housing when communicating direct to outside or $5/100^{th}$ 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.

The high pressure stage of installations should be located external to premises. If located inside a housing, the pressure regulator should be sited so that the length of the high pressure hose does not exceed 1 m per cylinder. Whenever possible, service and reserve cylinders should be connected to a manifold fitted with non-return valves, which allows one cylinder to be removed for changing without shutting down the whole system. Ideal arrangements are shown in Figure 3.

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

The appropriate size of pressure regulator should be determined according to the maximum gas rate, calculated according to Table 1.

The regulator may be fitted directly to the cylinder valve outlet for single cylinder use, or mounted separately on a manifold for multiple cylinder use.

Multiple cylinder installations should be fitted with an emergency control valve located externally at the point where the supply enters the premises. The valve should be clearly identified and its direction of closure indicated, in accordance with The Gas Safety (Installation and Use) Regulations [1], [2].

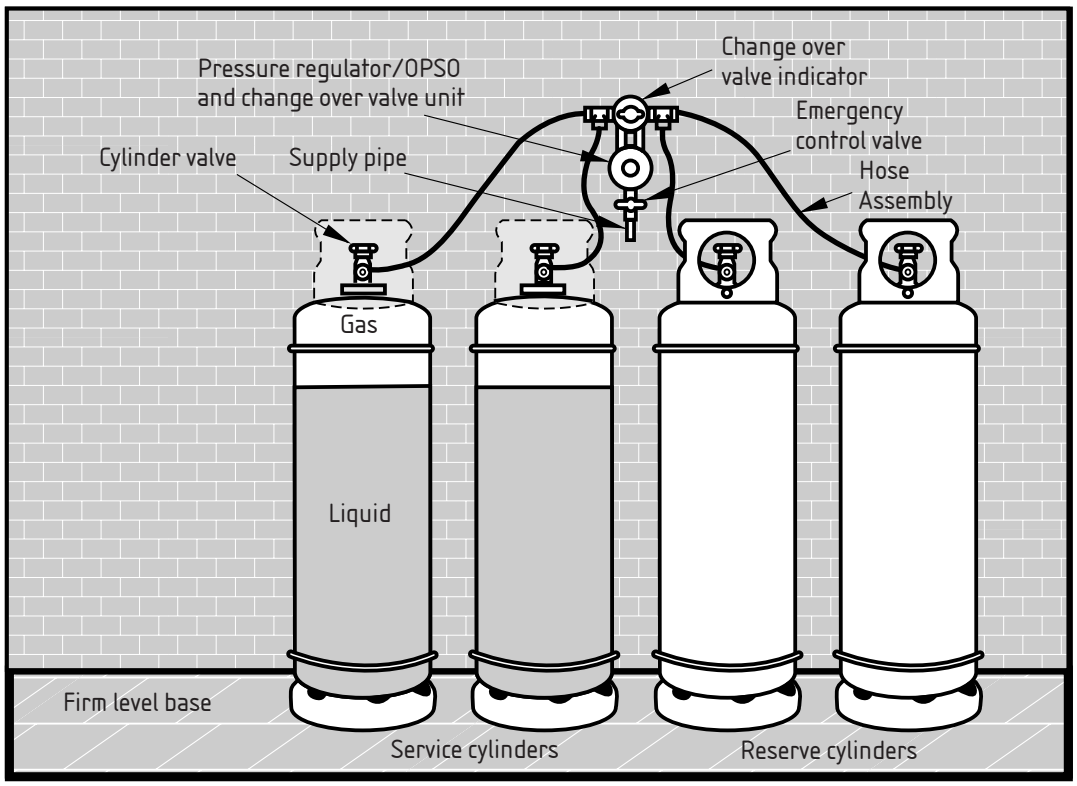


Figure 3 — Typical 4 × 47 kg cylinder installation

11.4.3 *Intermediate pressure stage design*

Where pressure loss is an issue, the external pipework may be run at intermediate pressure. This should be in consultation with the gas supplier.

An intermediate pressure stage system has a first stage regulator mounted at, or close to, the tank or cylinder outlet valve and provides an outlet pressure in the order of 1 bar. The second stage regulator, set at the appliance operating pressure, may be either tank mounted or installed at the dwelling (normally wall mounted). For MDPE service pipework installations, it is essential that an OPSO facility is fitted upstream of that section of pipe. For cylinder installations the same arrangement applies, however, the first stage regulator usually incorporates an automatic changeover device and the second stage regulator is normally either close coupled, or incorporated in the same housing as the first stage regulator.

11.4.4 *Low pressure stage design*

11.4.4.1 *General*

Bulk tank installations should incorporate an under pressure shut-off device (UPSO) which will operate if the gas supply pressure falls to a dangerously low level, e.g. because the storage vessel has become empty.

Bulk tank installations should also incorporate an over pressure shut-off device (OPSO) which will operate if the gas supply pressure rises to a dangerously high level, e.g. because the low pressure regulator has failed.

11.4.4.2 *Installation pipework sizing*

Pipes should be of such internal diameter and length as to ensure that there will not be a pressure drop greater than 2.5 mbar between the outlet of the pressure regulator and any draw-off point when the installation is subjected to the anticipated maximum load.

NOTE 1 The internal diameter of installation pipework is determined by the maximum gas rates of the appliance(s) to be connected (see Table 3).

It is essential that the pressure drop is divided between the service and installation pipework. In most cases the installation pipework cannot be determined at the time the service pipework is sized, therefore the service pipework should be sized with a maximum pressure drop of 0.5 mbar.

Allowance should also be made for the possibility of future extensions, especially if the pipes are to be buried.

Annex B gives a method of calculating pipe sizes in a system.

Table 3 — Pipe sizing[a]

BS steel pipe								
Length of tubing	**Internal diameter**							
	¼ in		**½ in**		**¾in**		**1 in**	
m	kW	m^3/h	kW	m^3/h	kW	m^3/h	kW	m^3/h
3	13.2	0.50	110	4.25	220	8.50	483	18.70
6	9.1	0.35	73	2.83	154	5.95	330	12.74
9	7.6	0.29	59	2.26	121	4.67	256	9.91
12	6.4	0.25	51	1.98	102	3.96	220	8.50
15	5.9	0.23	44	1.70	88	3.40	190	7.36
18	5.3	0.20	40	1.53	80	3.11	175	6.80
21	5.0	0.19	37	1.42	75	2.92	161	6.23
24	4.7	0.18	33	1.27	70	2.72	146	5.66

Metric copper tube										
Length of tubing	**outside diameter**									
	6 mm		**10 mm**		**15 mm**		**22 mm**		**28 mm**	
m	kW	m^3/h	kW	m^3/h	kW	m^3/h	kW	m^3/h	kW	m^3/h
3	2.93	0.12	22.60	0.88	38.4	1.49	207	8.01	412	15.92
6	2.05	0.085	14.65	0.57	26.1	1.01	135	5.21	230	8.86
9	1.76	0.071	12.31	0.48	20.5	0.79	108	4.19	215	8.33
12	1.47	0.059	10.84	0.42	17.9	0.70	94	3.62	187	7.25
15	1.17	0.048	9.67	0.38	15.5	0.60	82	3.20	168	6.51
18	1.17	0.048	8.79	0.35	13.5	0.53	74	2.86	145	5.61
21	0.88	0.040	8.21	0.32	12.9	0.50	67	2.58	135	5.24
24	0.88	0.040	7.62	0.29	12.0	0.47	61	2.38	126	4.87

Polyethylene pipe					
Length of tubing	**Outside diameter 25 mm**		**Length of tubing**	**Outside diameter 32 mm**	
m	kW	m^3/h	m	kW	m^3/h
30	58.96	2.22	80	61.8	2.34
40	50.9	1.93	100	54.6	2.07
50	45.6	1.73	120	50.8	1.92
60	41.8	1.58	140	47.1	1.78
70	38.6	1.46	160	44.0	1.67
			180	41.5	1.57
			200	39.3	1.49
			220	37.0	1.40

NOTE 1 The pipe sizing table applies to steel tubes in accordance with BS 1387 and copper tubes in accordance with BS EN 1057:1996. For a tube with a bore substantially different from the bores of any of these tubes the pressure drop can be obtained by interpolation.

NOTE 2 For a given rate of flow in a given pipe the pressure drop for propane at 37 mbar equals approximately 0.75 of the pressure drop for butane at 28 mbar.

NOTE 3 A given pipe with butane at 28 mbar will carry approximately the same volume equivalent as it would with propane at 37 mbar.

NOTE 4 The size of pipe determined by using Table 4 will not be suitable for use with Natural Gas if conversion is necessary in the future.

[a] These figures are based upon the use of propane at low pressure of 37 mbar and a maximum pressure drop of 2.5 mbar.

The equivalent lengths of pipe for fittings are as given in Table 4. See Annex B for a worked example.

Table 4 — Equivalent lengths of pipe for fittings

Fitting	Length m
Elbow	0.6
Tee	0.6
Straight coupler	0.3
90° bend	0.3
Globe valve (15 mm)	1.0
Globe valve (22 mm)	1.4

11.4.4.3 *Flexible hoses*

Flexible hoses should only be used for:

a) *cylinder connections*. Where manifolds are fixed other than directly to the cylinder valve, it is essential that the connecting tube is a high pressure flexible hose assembly with factory-made connections conforming to BS 3212:1991, Type 2, to allow for movement when cylinders are being changed;

b) *connections for movable appliances*. Flexible hoses should conform to the relevant requirements of BS 669. A flexible hose should not be used where it might be subjected to a temperature above 50 °C.

NOTE Flexible hoses conforming to BS 669 may be used for cooker connections provided that they are marked to identify their suitability for LPG applications.

Flexible connections should be as short as practicable whilst being long enough to provide the necessary flexibility without excessive strain on the hose or the end fittings. Rigid pipework should be used wherever possible.

Flexible hoses should not extend from one room to another, nor pass through any walls, partitions, ceilings, or floors.

For residential park homes it is essential to ensure that the connection between the gas supply pipe and the gas inlet on the home is via a flexible hose with a minimum length of 300 mm and a maximum length of 1000 mm.

Where a flexible hose is used for an appliance connection, an appliance isolation valve should be fitted to the rigid pipework in a readily accessible position immediately prior to the flexible connection.

11.4.4.4 *Emergency control*

Bulk tank and cylinder installations comprising two or more cylinders should be fitted with an emergency control which is located at a point external to each premises and as near as practicable to the point where the gas supply enters the premises.

The emergency control should be clearly identified, readily accessible to all consumers and its direction of closure or opening indicated either on the control itself or on a nearby permanent notice.

An emergency control should be protected against unauthorized operation, but if situated in a locked compartment, the occupiers of the premises should be provided with keys. In such cases the emergency service provider should also hold keys where access cannot be ensured for them at all times.

The emergency control may be operated by a key, lever or hand-wheel which should be securely attached to the operating spindle. Where a key or lever is used, it should be attached so that it is parallel to the axis of the pipe in which it is installed when the control is in the open position. The off position should be approximately one quarter turn of the lever or key to the left or right, and where the key or lever moves in a vertical plane, the move to the off position should be in a downwards direction.

The person allowing the flow of gas into the premises should ensure that every gas consumer in the premises is aware of the location of their emergency control, and the action to be taken in the event of a gas emergency.

The gas inlet point on the installation should be securely fixed and readily accessible. In the case of cylinders situated in fire-resistant housings, the connection should be situated within the housing.

NOTE For single cylinder installations, the cylinder valve may be considered as the emergency control valve.

A valve should be fitted in an accessible position at the point of exit from a dwelling where the installation pipe leaves to supply remote appliances.

11.4.4.5 *Primary meter*

The installation of the primary meter should conform to the relevant part of BS 6400.

11.5 Ventilation

11.5.1 *Ventilation in permanent dwellings*

Ventilation should be provided in accordance with BS 5440-2.

11.5.2 *Ventilation in residential park homes*

Ventilation should be provided in accordance with BS 3632.

In addition to ventilation openings at low-level, it is essential that gas dispersal holes are provided. These should be directly underneath or adjacent to the gas appliance. These holes are intended to provide an escape route for unburnt LPG, which may be accidentally released by the appliance. Dispersal holes should be of not less than 25 mm internal diameter.

NOTE A ventilation opening under a gas appliance may serve as a dual purpose and be considered also as the provision of a gas dispersal hole.

12 Installation

12.1 General

Pipework should be physically protected against, or located where it is not liable to be subject to, mechanical damage. The bore should not be restricted by kinks, burrs, foreign matter or in any other way.

12.2 Safety precautions

12.2.1 While installation work is in progress, care should be taken to prevent the ingress of dirt, water, etc. into pipes.

12.2.2 Where work is in progress on pipes already connected to a gas supply either:

a) the gas supply should be temporarily disconnected and both the open ends of the pipework sealed and dust caps fitted to the meter; or

b) all open ends of the pipework should be plugged, capped or terminated with a self-sealing appliance connector conforming to BS 669 before the work is left unattended.

12.2.3 When work has been completed, open ends of pipe should be plugged, capped or terminated with a self-sealing appliance connector conforming to BS 669.

12.2.4 Before any work is commenced with a naked flame, e.g. a blow lamp, on pipework that contains or has contained gas, the gas supply to that part of the pipework should be isolated, disconnected and purged. The open ends of pipework connected to the gas supply should be plugged or capped.

Naked flames should be kept away from the open ends of pipework.

In no case should oxy-gas flame cutting equipment be applied to any meter, pipe or fitting containing gas.

NOTE Information on purging is given in **13.2**.

12.3 Connection and disconnection of pipes and fittings

12.3.1 Where any installation pipework is no longer required, the pipe(s) should be disconnected as close to the point of supply as practicable and purged. All pipe ends should be sealed, e.g. with a plug or cap.

12.3.2 During any work that necessitates connection or disconnection of any installation pipework, a temporary electrical continuity bonding connector should be fixed securely to the pipework either side of any intended connection or disconnection point or between the pipework and any fitting to be installed or removed. Such a temporary electrical continuity bond should always be used irrespective of any permanent equipotential bonding that is installed.

12.3.3 The following procedure is recommended for the use of the temporary electrical continuity conductors:

a) securely isolate the electrical connection of any associated gas appliance(s) from the mains electrical supply;

b) secure the temporary electrical continuity bonding conductors either side of the union, fitting or complete pipe section to be installed or removed, ensuring that the connection is effective and efficient;

c) carry out the work leaving the temporary electrical continuity bonding conductors in place until the work has been completed. Where pipework is to be removed ensure that both sections of pipework left are bonded before removing the two temporary electrical continuity bonding conductors.

Any temporary electrical continuity bonding conductor should comprise a length of at least 1.2 m of single-core insulated flexible cable with a minimum cross-sectional area of not less than 10 mm^2 (copper equivalent) with an insulation rating of not less than 250 V a.c. The cable should be multi-stranded and be constructed in accordance with BS 6004, BS 6007 or BS 6231 with a robust clamp or clip securely attached to each end (see Figure 4).

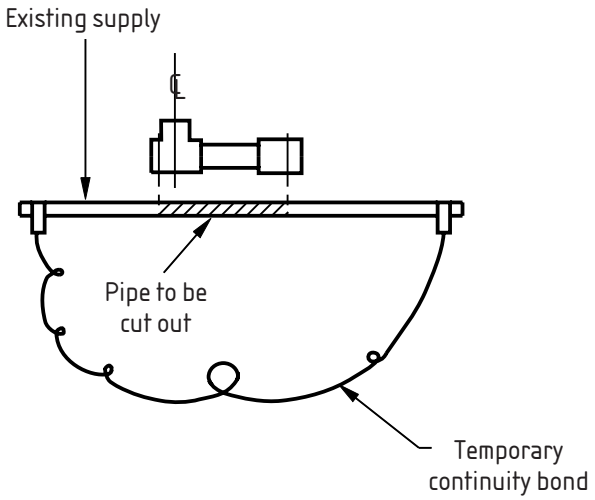


Figure 4 — Use of temporary electrical continuity bonding connector

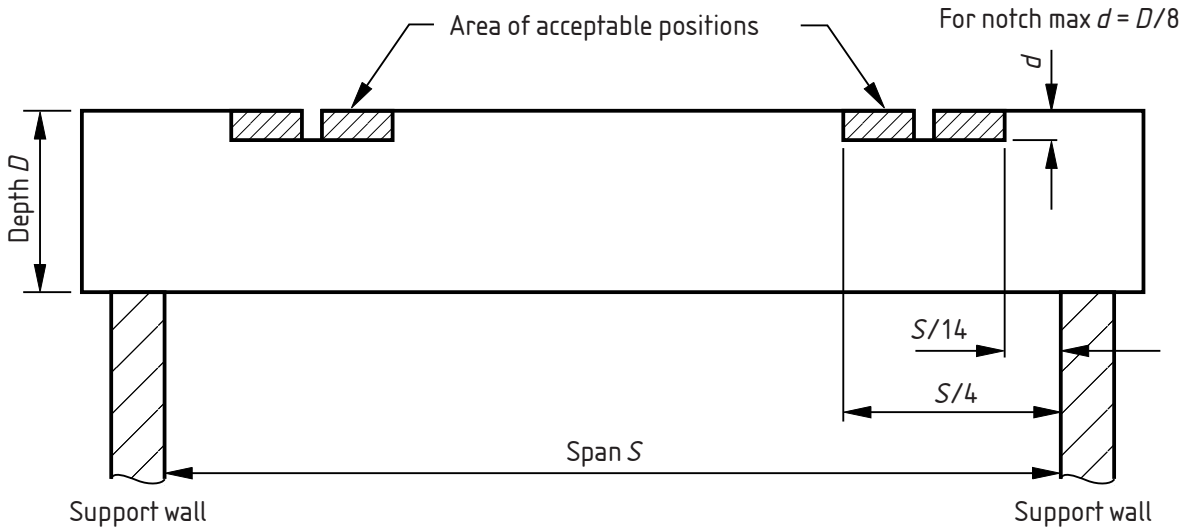
12.4 Pipes laid in wooden joisted floors

12.4.1 Where pipes are installed between joists in floor or roof spaces, they should be supported to prevent movement.

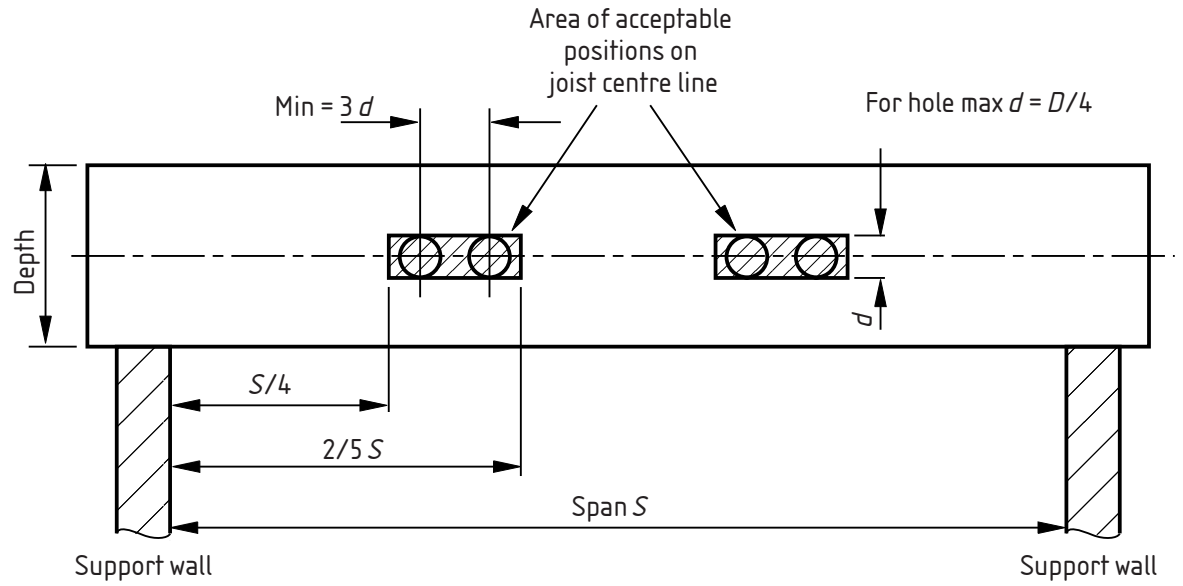
12.4.2 Where pipes are laid across the joists in ceiling or roof spaces fitted with flooring they should be located in purpose-made notches or circular holes.

Notches should not be made in joists less than 100 mm deep. Notches should be in accordance with Figure 5.

Prior to running pipework below suspended floors a visual inspection should be carried out to note the position of any electrical cables, junction boxes and ancillary equipment, in order that accidental damage or injury does not occur when inserting pipework. Care should be taken when refixing flooring to prevent damage to the pipes by nails or screws. Where possible, the flooring should be appropriately marked to warn others.



a) Timber joist notching



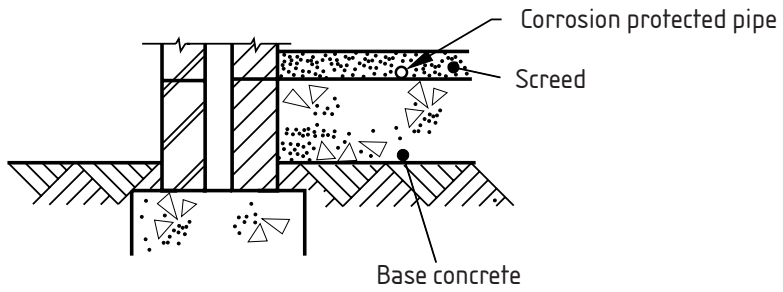
b) Timber joist drilling

Figure 5 — Pipe joists

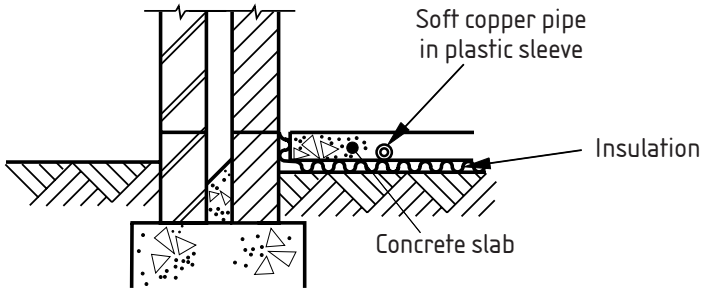
12.5 Pipes laid in concrete floors

12.5.1 Except for corrugated stainless steel pipe conforming to BS 7838, stainless steel pipework should not be buried in concrete.

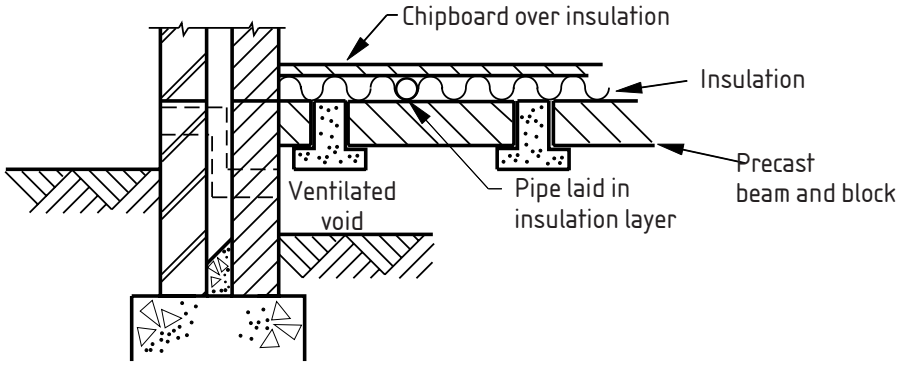
Examples of laying pipes in concrete floors are given in Figure 6.



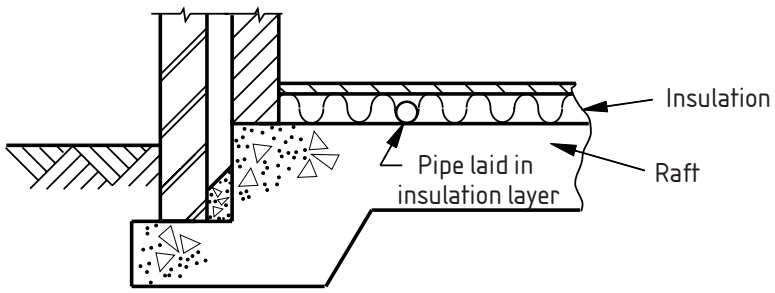
a) Screed



b) Ground bearing slab



c) Precast beam and block



d) Raft

Figure 6 — Typical examples of buried pipes

12.5.2 Pipes laid in concrete floors should be protected against failure caused by movement. Joints should be kept to a minimum. Compression fittings should not be located in the floor slab. Pipework should be suitably protected by one of the following means.

a) Fully annealed factory-sheathed copper tube passed through a larger sized plastics tube sleeving previously set into the floor slab and base hard core. Joints should not be located within the larger plastics tube sleeving.

b) Pipe laid on top of base concrete and subsequently covered by a screed.

c) Steel or copper pipe fitted with additional soft covering material. The coverings should be soft and thick enough to provide movement yet resilient enough to support the concrete cover while it is setting. The covering should be at least 5 mm thick and resistant to concrete ingress which would negate its ability to allow movement.

Reference should also be made to **9.1** for the application of adequate corrosion protection.

12.5.3 Pipes passing vertically through solid floors should take the shortest practicable route and should be sleeved.

12.5.4 Compression fittings and pipe fittings conforming to BS 7838 should not be buried in the structure or below-ground.

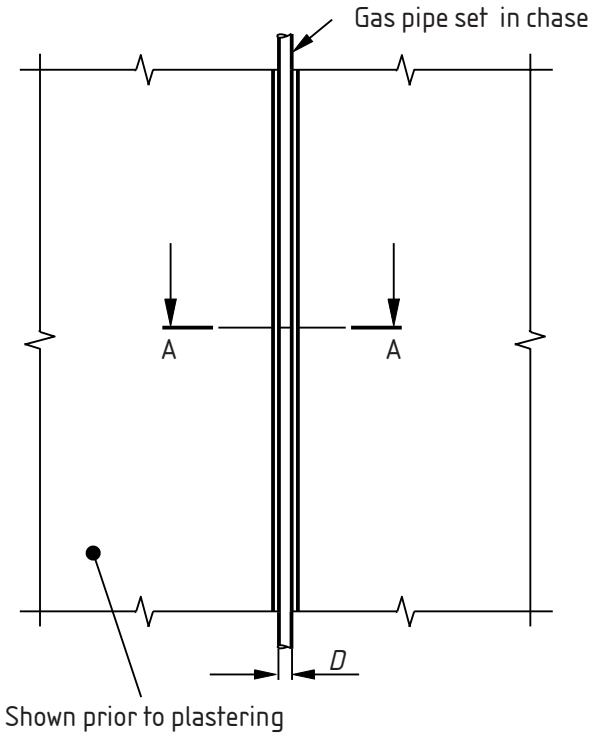
12.6 Pipes laid in walls

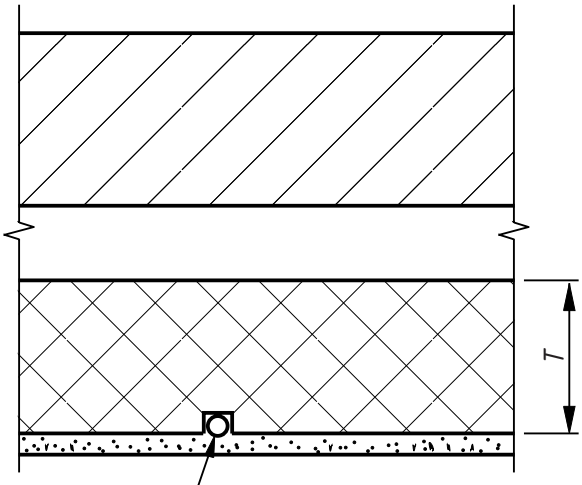
12.6.1 *Pipe runs*

Installation pipe in walls should, where possible, be vertical and should be placed in ducts with convenient access points or placed in pipe chases.

NOTE Typical methods of installing pipes in walls are shown in Figure 7.

The installation pipe should be secured, have a minimum number of joints, and be adequately protected against corrosion (see **9.1**).

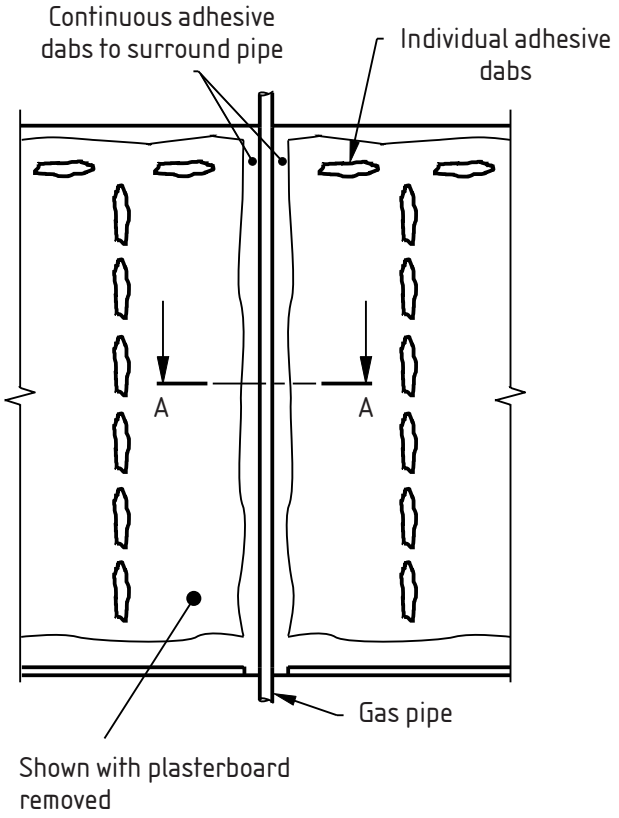


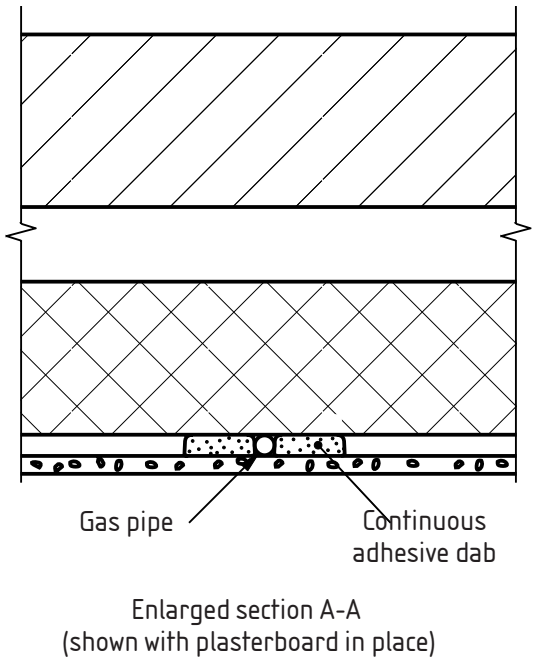


Enlarged section A-A
(shown after plastering)

a) Brick and block plastered

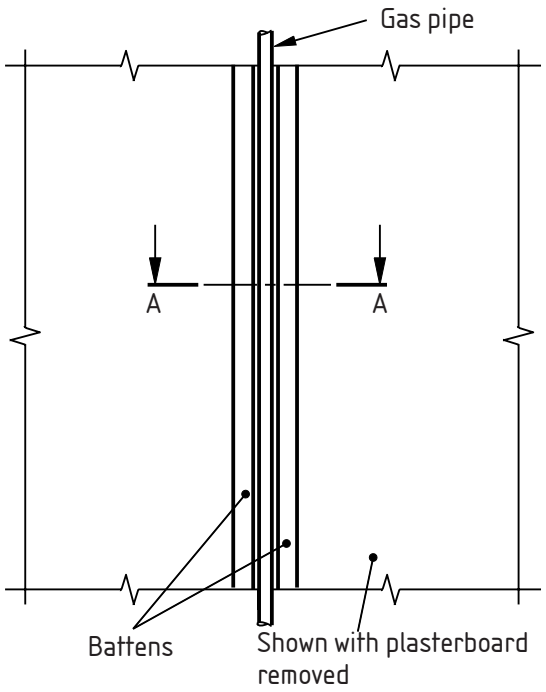
Figure 7 — Typical examples of pipes in masonry and timber frame walls

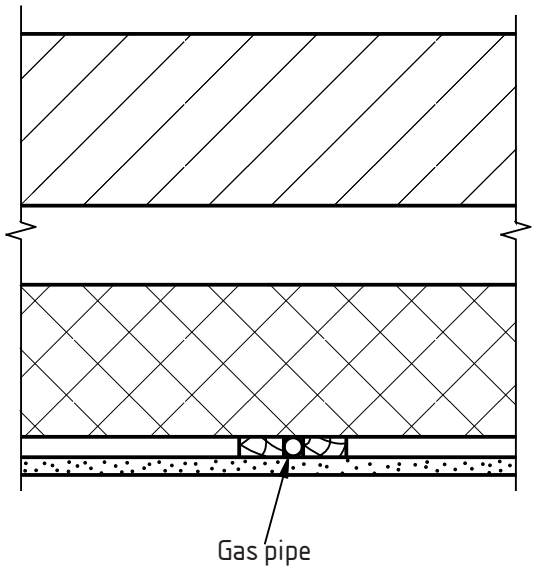




b) Brick and block with plasterboard on dabs

Figure 7 — Typical examples of pipes in masonry and timber frame walls (*continued*)

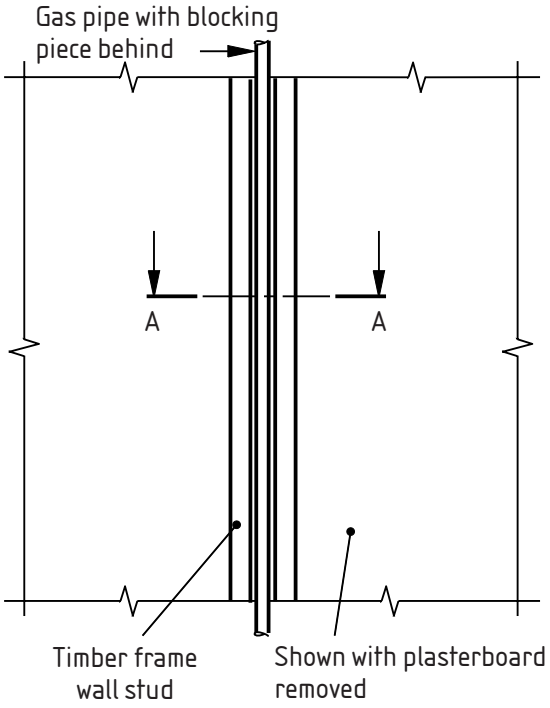


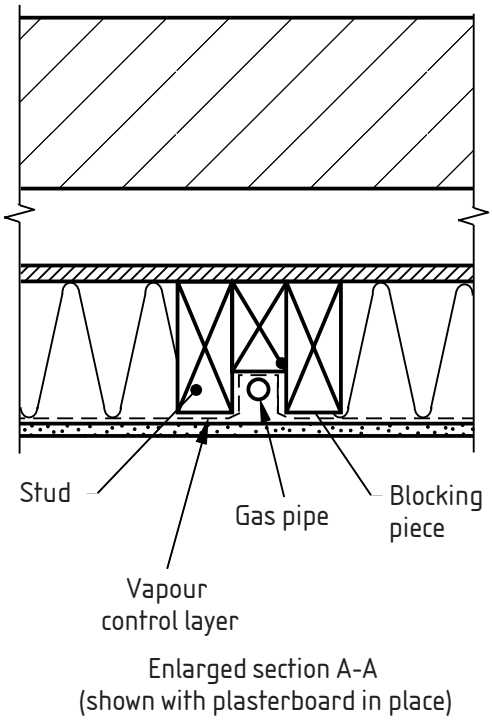


Enlarged section A-A
(shown with plasterboard in place)

c) Brick and block dry lined on battens

Figure 7 — Typical examples of pipes in masonry and timber frame walls (*continued*)





d) Timber construction

Figure 7 — Typical examples of pipes in masonry and timber frame walls (*continued*)

12.6.2 *Cavity walls*

Pipe passing through a cavity wall should take the shortest practicable route and should be sleeved.

12.6.3 *Dry-lined walls*

Installation pipes installed behind dry lining should be encased by building material.

12.6.4 *Timber construction walls*

Installation pipes installed within timber construction walls should:

a) be run within purpose-designed channels or ducts;

b) be adequately secured to studding;

c) have the minimum number of joints;

d) be protected where appropriate from mechanical damage due to movement;

e) be adequately protected against corrosion.

12.6.5 *Sleeving of pipes through walls*

12.6.5.1 Every pipe passing through a wall should be sleeved. Sleeves should be of a material capable of containing or distributing gas safely, e.g. copper, steel, MDPE, poly(vinyl chloride) (PVC), or other suitable plastics material.

Where practicable, sleeves should be sealed at least at one end to the pipe with a flexible, resistant compound.

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

The internal diameter of any sleeve should allow for an annular space around the pipe to enable satisfactory insertion of the pipe into it. A pipe sheath having small internal interstices to allow pipe movement may be used.

12.6.5.2 Screwed, push-fit and compression joints should not be located within the sealed section of a sleeve.

12.6.5.3 Sleeves should be sealed at each end to the structure with a building material, e.g. cement mortar or plaster.

12.7 Pipework in ducts

12.7.1 *Ventilation*

Vertical and horizontal ducts containing installation pipes should be ventilated to ensure that gas leakage does not cause the atmosphere within the duct to become unsafe.

NOTE 1 The level of ventilation is not intended to clear a major gas escape arising from damage or failure of a gas pipe.

NOTE 2 The duct may run freely through a number of storeys or take the form of an enclosure at each storey level. Where ducts are continuous, ventilation can normally be achieved by the provision of openings. Where the duct takes the form of an enclosure at each storey level, ventilation is normally required at high level only in each storey.

Ducts should be ventilated in accordance with Table 5. Ducts having a small cross-sectional area and volume (i.e. 0.001 m^2 or less and 0.1 m^3 or less respectively) are considered to be adequately ventilated by adventitious means and no additional openings are required.

NOTE The normal minimum period of fire resistance of the duct is 30 min for buildings of not more than three storeys. Further guidance on the fire resistance of buildings is given in the appropriate Building Regulations [4], [5] and [6].

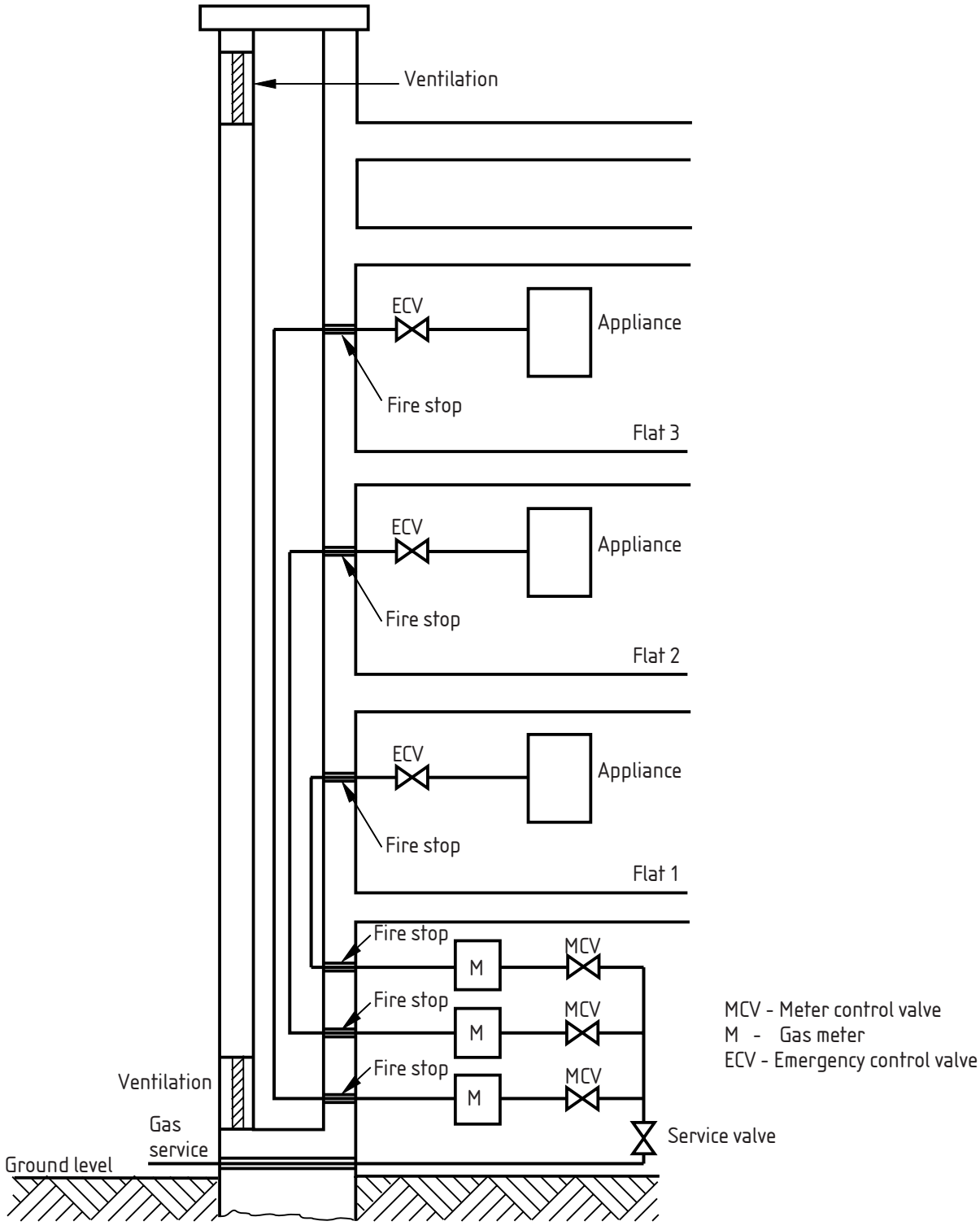
Table 5 — Free area of ventilation openings

Cross-sectional area of duct m^2	Minimum free area of each opening m^2
≤ 0.01	0
> 0.01 and ≤ 0.05	equal to cross-sectional area of duct
> 0.05 and ≤ 7.5	0.05
> 7.5	equal to 1/150th of the cross-sectional area of duct

12.7.2 *Fire stopping*

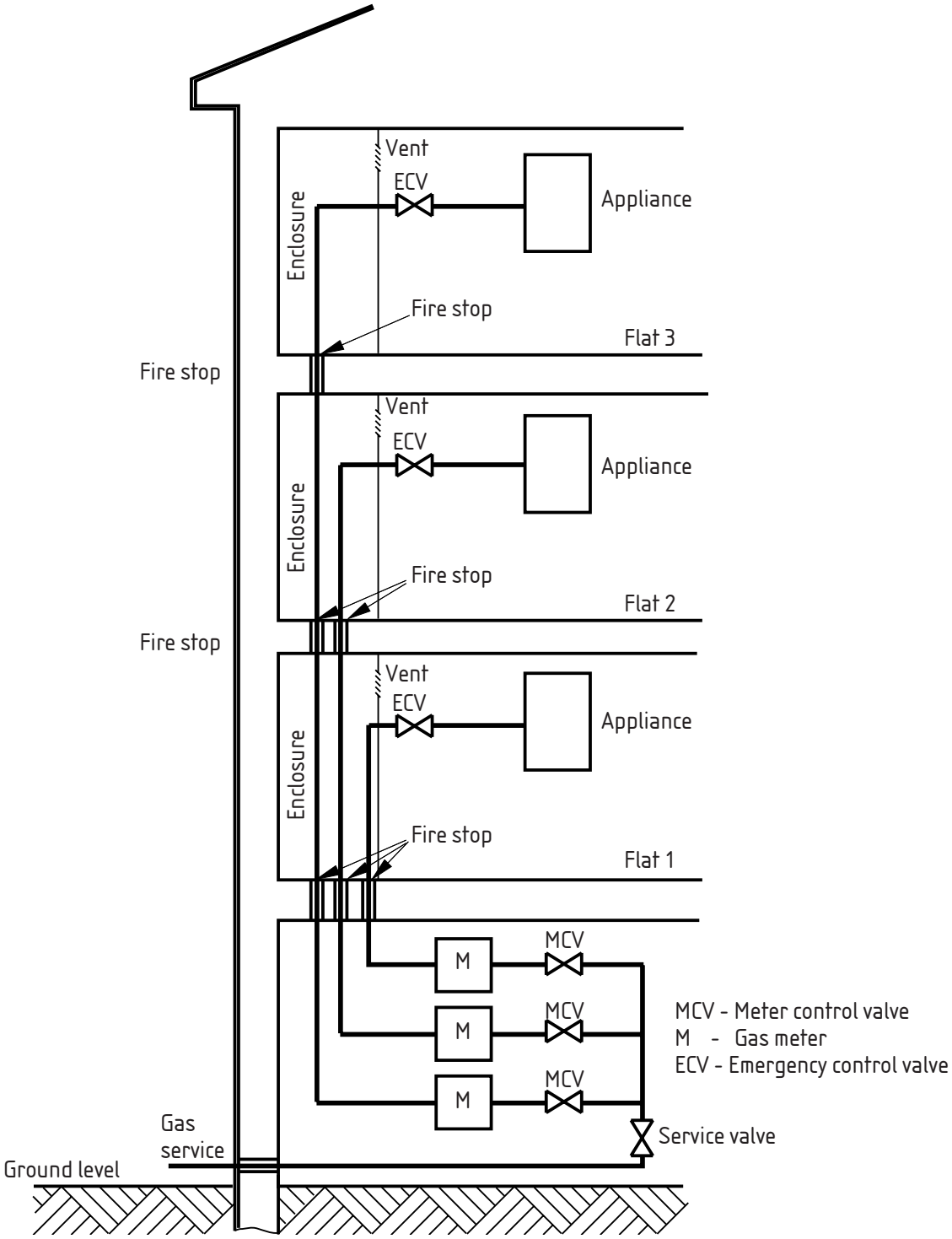
For buildings containing flats and maisonettes, installation pipes should be fire stopped as they pass from one floor to another unless they are in their own protected shaft which is ventilated top and bottom to the outside atmosphere. When installation pipes from a continuous duct enter a flat or maisonette they should be fire stopped at the point of entry (see Figure 8).

NOTE When pipes pass through the protecting structure (i.e. compartment walls or floors), all openings should be kept as small and as few in number as practicable, and should be suitably fire stopped in such a manner as to allow thermal movement of the pipe and ensure the fire resistance is not impaired. To prevent displacement, materials used for fire stopping should be supported by, or reinforced with, materials of limited combustibility. Any proprietary fire stopping should, when tested in accordance with the appropriate part of BS 476, achieve the relevant periods of fire resistance for the structure in respect of load bearing capacity, integrity and insulation.



a) Ventilated duct

Figure 8 — Typical installation pipework in multi-storey buildings containing flats or maisonettes



b) Fire stopped pipework and ventilated enclosed area

Figure 8 — Typical installation pipework in multi-storey buildings containing flats or maisonettes (*continued*)

12.8 Pipework inside a protected shaft containing a stair and/or lift or other protected fire escape route

Any pipe carrying gas installed in or passing through a protecting structure should be of screwed steel or of all-welded steel construction.

NOTE Neither copper pipework nor corrugated stainless steel is acceptable inside a protected shaft. A protected shaft containing gas installation pipes should be ventilated at high and low levels direct to the outside air. Further guidance on protected shafts is given in the appropriate Building Regulations Approved Documents [4], [5] and [6]. The recommendation given in **12.8** does not normally apply to one or two storey domestic dwellings.

12.9 Pipe supports and fixings

Installation pipes should be supported, with the maximum intervals between pipe supports as given in Table 6.

Table 6 — Maximum interval between pipe supports

Pipe material	Nominal size of pipe	Interval for vertical run m	Interval for horizontal run m
Mild steel	≤DN 15 (R1/2)	2.5	2.0
	DN 20 (R3/4)	3.0	2.5
	DN 25 (R1)	3.0	2.5
Copper	≤ 15 mm	2.0	1.5
	22 mm	2.5	2.0
	28 mm	2.5	2.0
Corrugated stainless steel	DN 10	0.6	0.5
	DN 12	0.6	0.5
	DN 15	0.6	0.5
	DN 22	0.6	0.5
	DN 28	0.6	0.5

The supports used should be designed to prevent the pipe coming into contact with surfaces of the structure which are likely to cause corrosion.

NOTE Timber is a notable example of a material where contact is unlikely to cause corrosion. Other acceptable types of support include those made from metal (see BS 1494-1 and BS 3974-1) and plastics materials.

12.10 Buried pipework

Buried pipework in open soil areas where the risk of damage is negligible should have at least 375 mm of cover.

Buried pipework below vehicular traffic areas should have at least 600 mm of cover.

Buried pipework in or below concrete which has only pedestrian traffic should have at least 100 mm cover.

Compression fittings conforming to BS EN 1254-2 and pipe fittings which conform to BS 7838 should not be buried below-ground.

The use of fittings should be kept to a minimum, and, where aesthetically and practicably acceptable, bends should be used in preference to elbows.

NOTE Further information on pipework is given in LPGA Code of Practice 22 [8].

12.11 Interrelation with other services

12.11.1 *General*

Installation pipework should be located or electrically insulated so that it does not touch metallic fitments which can give rise to electrolytic corrosion.

LPG installation pipes:

a) should not be installed in a ventilation or air-conditioning duct;

b) should not run adjacent to, or in, the same duct as a drainage service;

c) should be separated from, and not in the same duct as, electricity or telecommunication services.

The application of electrical insulating tapes should provide adequate protection where spacing is impracticable. Care is essential when installing gas pipework in buildings containing electrical damp-proof protection systems to prevent accelerated pipe corrosion from occurring.

12.11.2 *Spacing*

Where installation pipes are not separated by electrical insulating material, they should be spaced as follows:

a) at least 150 mm away from electricity meters and associated excess current controls or fuse boxes;

b) at least 25 mm away from electricity supply and distribution cables, and other metallic services.

NOTE For maintenance and inspection services, in item b) 50 mm is a more practical distance.

Where the spacing requirements are impracticable the pipe should either be poly(vinyl chloride) wrapped or a panel of insulating material should be interposed.

12.11.3 *Electrical services*

Care should be taken not to damage any electrical conductor when installing pipework. Installation pipes should not be buried in floors where electrical under-floor heating is installed, unless it has been physically and permanently disconnected.

12.11.4 *Main equipotential bonding (cross-bonding)*

12.11.4.1 All gas installation pipework should be connected to the main earthing terminal of the electrical installation in accordance with BS 7671 (formerly known as the IEE Wiring Regulations).

NOTE The purpose of electrical bonding is to create a zone in which voltage differences, and therefore hazards from electric shocks and sparks, are reduced. This is achieved by connecting separate conductive components together with suitable electrical conductors or via electrically continuous metal pipework. If an electrical fault occurs, either inside or outside of a building, it is possible for stray currents to be transmitted through the gas installation pipework. With a PME (protective multiple earth) system, a small current can pass along the pipework under normal conditions. Therefore, to avoid electric shock, or a spark which could ignite the gas, it is important to maintain electrical continuity in the pipework at all times and particularly when separating pipework and fittings (see requirements 413-02-02, 547-02-01 and 547-02-02 of BS 7671:2001).

12.11.4.2 *Main equipotential bonding should be connected:*

a) on the user's side of any meter or any insulating insert;

b) as close as practicable to the meter before any branch in the installation pipework;

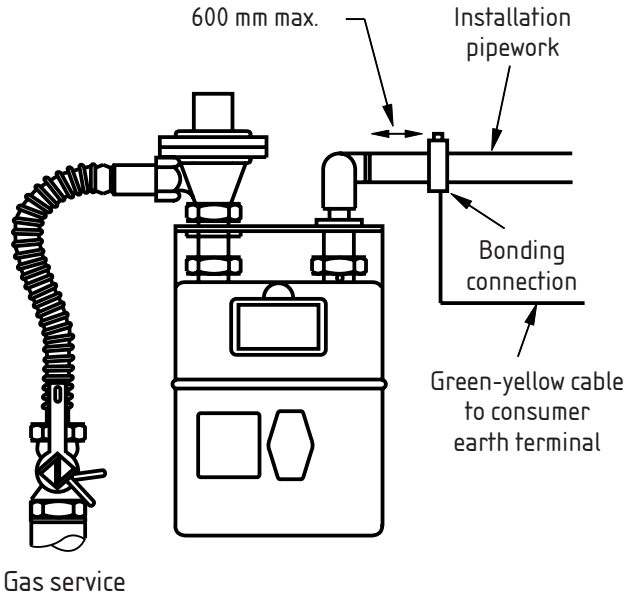
c) in a position where it can be visually observed, with a warning label stating "Safety electrical connection. Do not remove"; and

d) on hard metal pipework by a mechanically and electrically sound connection which is not subject to corrosion (i.e. not exposed to the weather).

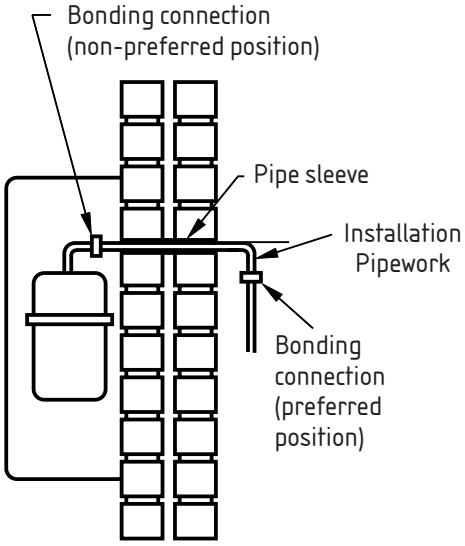
The main equipotential bonding of the gas installation pipework should be carried out using a flexible single-core multi-stranded copper-insulated conductor with a minimum cross-sectional area of not less than 10 mm^2. The insulation should be the bi-colour combination of green and yellow (see BS 6004:2000 reference 6491x).

12.11.4.3 When a gas installation pipe is connected to a gas supply, the installer of the installation pipe should, in the case where the main equipotential bonding may be necessary, either install the bonding if qualified to do so, or inform the responsible person that such bonding should be carried out by a competent person.

NOTE For new gas installations the responsibility for the main equipotential bonding lies with the installer, to carry out the bonding directly, preferably, where competent to do so, or, alternatively, pass notification (e.g. a letter or card) to the person responsible (e.g. house owner, tenant, landlord or builder).



a) Front view



b) Side view

Figure 9 — Position of mains equipontential bond (electrical cross-bonding)

12.12 Installation of unions, fittings, and valves

Where joints other than screwed, compression, or capillary-type are used, brazing, welding or hard soldering (with a melting point above 450 °C) should be employed.

All joints should be made in such a manner as to avoid undue stress on the fitting.

12.13 Installation of appliances

12.13.1 *General*

Appliances should be installed in accordance with The Gas Safety (Installation and Use) Regulations [1], [2], the manufacturer's instructions and any British Standard(s) relevant to the particular appliance.

It is essential that an LPG appliance with a pilot light or automatic ignition device is not installed in a basement or cellar.

Appliances should be connected in such a manner as to eliminate undue stress on the pipework or fittings.

The installer should provide the user with all the appliance manufacturer's instructions and warnings accompanying the appliance.

12.13.2 *Avoidance of fire risk*

The surfaces of adjacent structures in contact with the appliance should be of materials that can withstand temperatures of 65 °C.

Where combustible material adjacent to an appliance might otherwise have a temperature rise in excess of 50 °C, it is essential that provision be made to protect the material.

NOTE Such protection can be afforded by mounting a sheet of durable non-combustible material between the appliance and the combustible material so as to provide a ventilated air space of not less than 25 mm between the sheet and the combustible material.

In certain cases similar considerations will apply to surfaces immediately above the appliances, when the same precautions should be taken.

12.13.3 *Installation of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances, and flueless space heaters*

12.13.3.1 Gas fires, convector heaters and fire/back boilers should be installed in accordance with BS 5871-1.

12.13.3.2 Inset live fuel effect gas fires of heat input not exceeding 15 kW should be installed in accordance with BS 5871-2.

12.13.3.3 Decorative fuel effect gas appliances of heat input not exceeding 15 kW should be installed in accordance with BS 5871-3.

12.13.3.4 Flueless space heaters should be installed in accordance with BS 5871-1, and should not have a heat input greater than:

— 50 W/m^3 of heated space when fitted in a room; or

— 100 W/m^3 in any other heated spaces, e.g. a hall.

See BS 5440-2.

12.13.4 *Installation of gas refrigerators*

12.13.4.1 *A refrigerator should be installed in accordance with the manufacturer's instructions and so that it is level, both from front to back and side to side.*

NOTE A refrigerator should preferably not be installed next to an oven or any continuously burning appliance, since this may impair its performance.

12.13.4.2 The installer should ensure that there is adequate ventilation for combustion purposes and for cooling the absorption unit.

12.13.4.3 Air ducts for the ventilation of a built-in refrigerator should be in accordance with the manufacturer's instructions to ensure safe and satisfactory operation of the refrigerator.

12.13.4.4 When flued to the outside air, the flue supplied should incorporate an effective draught diverter to reduce the risk of the burner being extinguished during windy conditions.

12.13.5 *Installation of gas central heating wet systems*

The installation of a water-filled system should be in accordance with BS 5449, BS 5546, BS 6700 and BS 6798 (for boilers of rated heat input not exceeding 60 kW). Boilers of rated input between 60 kW and 2 MW should be installed in accordance with BS 6644.

12.13.6 *Installation of gas water heaters*

The installation of water heaters should be in accordance with BS 5546.

12.13.7 *Installation of gas central heating warm air systems*

The installation of warm air systems should be in accordance with BS 5864.

12.13.8 *Installation of gas cookers*

The installation of domestic gas cooking appliances should be in accordance with BS 6172.

12.13.9 *Installation of gas-fired tumble dryers*

The installation of gas-fired tumble dryers should be in accordance with BS 7624.

13 Inspection, testing and user instructions

13.1 Inspection and testing of new installations

The complete system comprising the high pressure stage, low pressure stage and an intermediate pressure stage, when used, should be tested by the installer using the methods given in Annex A.

NOTE 1 The test(s) may take the form of one single test on the complete installation; alternatively the installation pipes may be tested separately first.

The adjustment of appliances should be in accordance with the manufacturer's instructions.

13.2 Purging installation pipework

Every new or rearranged installation pipe should be purged of air after satisfactorily passing the soundness test (see Annex A) and being connected to the gas supply.

During the purging operation, gas should not be allowed to accumulate in any confined space. Steps should be taken within the vicinity of the purge point to ensure good ventilation, to prevent inadvertent operation of any electric switch or appliance and to prohibit smoking or naked lights.

Purging of diaphragm meters should be effected by passing a volume of gas not less than five times the capacity per revolution of the meter mechanism e.g. $5 \times 0.07 = 0.35$ ft^3 for a U6 or G4 meter. E6 meters should be purged by passing not less than 0.010 m^3 of gas. All installation pipes should be purged commencing at the point(s) furthest from the primary meter.

NOTE Where an appliance is already connected, the purging may be carried out through the appliance.

13.3 User instructions

The installer should supply the user with the following:

a) all the equipment and the appliance manufacturer's instructions;

b) information from the gas supplier regarding the correct and safe handling of the system, and emergency procedures.

An example of an emergency action notice or leaflet is given in Annex C.

Annex A (normative)
Gas soundness testing of LPG service pipework, installation pipework, and appliances

A.1 General

These procedures are based on testing with a pressure gauge for pressure loss in the pipework and appliance system when under pressure with all inlets and outlets sealed. This is usually the most practical method. However, alternative procedures are possible. Pipework soundness is expected to meet the "no discernible pressure drop" criterion based on the use of a "U" gauge (low pressure) or a Bourdon gauge (intermediate pressure). These procedures therefore refer to the use of these gauges but more sensitive instruments may be substituted in which case they should be in accordance with the definition of "no discernible pressure drop" given in **A.1.1** and **A.1.2**.

NOTE Gas appliances for practical reasons are allowed a very small leakage, which may occasionally create a discernible pressure drop when complete installations are tested particularly if the pipework and appliance internal volume is small.

The permitted maximum leak-rates and equivalent pressure drops for typical installations given in Table A.1 and Table A.2 should be followed.

A.1.1 *No discernible drop using "U" gauge*

A pressure drop of 0.25 mbar or less on a "U" gauge is considered not discernible. Where "no discernible pressure drop" is required for the soundness test of pipework alone using a "U" gauge, 0.25 mbar is therefore still an acceptable pressure drop if measured by more sensitive instruments such as an electronic/digital gauge, providing they are regularly recalibrated in accordance with the manufacturers recommendations.

A.1.2 *No discernible drop using Bourdon gauge*

A Bourdon gauge should only be used for testing external service pipework which is to operate at intermediate pressure. "No discernible pressure drop" is assumed to be less than 5 mbar for a gauge with a maximum scale of 1 500 mbar and should be the acceptable limit when using a more sensitive instrument. The dial scale should be not less than 150 mm in diameter and preferably larger, and should be graduated every 5 mbar or closer.

A.1.3 *Calibration*

All gauges should be calibrated in accordance with the manufacturer's instructions.

A.2 Principle

These tests are intended to cover:

- domestic installations;
- small commercial installations;
- pipework and appliances with a total internal volume of 0.02 m^3 or less (e.g. this would equate to about 40 m of 20 mm pipe plus appliances for a typical domestic dwelling or 25 m if a gas meter was included).

Typical installations are shown in Figure A.1 to Figure A.5.

A test to ensure gas soundness should be carried out:

- before gas charging and commissioning of all newly-installed pipework, or extensions to existing pipework;
- whenever any work is carried out on an installation that might affect gas soundness;
- if a gas escape is suspected, or if there is a smell of gas;
- before re-establishing an existing gas supply.

A soundness test as given in **A.3** should be carried out for newly-installed pipework only, and comprise a test with air with appliances disconnected or isolated.

A soundness test as given in **A.4** comprises a test with LPG including appliances, and should be carried out either on an existing installation or, for newly-installed pipework, after the method given in **A.3**.

A soundness test as given in **A.5** should be carried out, and comprise a test with LPG of bulk tank service pipework from the tank outlet upstream of the first stage regulator to the emergency control valve at the premises (see Figure A.4 and Figure A.5).

A.3 Test method for soundness testing of a new installation with appliances disconnected or isolated at the appliance isolation valve and before gas charging

A.3.1 *Preparation*

Use air as the test medium. Cap or plug all open points in the system except for the one which will be used to admit air to the system.

A.3.2 *Procedure for service pipework designed to operate at greater than 37 mbar for propane or greater than 28 mbar for butane*

a) Connect an in-line test tee. Attach a pressure gauge to the test tee. If a Bourdon gauge is used, the dial should not be less than 150 mm diameter and the range should be such that the test pressure is not less than half full-scale.

b) Inject air into the system until the pressure gauge reads 1.5 times the operating pressure, e.g. for service pipework intended to operate at 0.75 bar gauge, the test pressure would be 1.125 bar gauge.

c) Isolate the pressure source.

d) Leave for at least 5 minutes to allow the temperature in the system to stabilize.

e) Note the pressure gauge reading.

f) Leave for 15 minutes.

g) Note the reading of the pressure gauge. The pipework is considered sound if there is no discernible pressure drop from that in **A.3.2**e). If the pressure has fallen, examine the entire installation and check each joint with leak detection fluid to locate the source of leakage.

h) Eliminate the leak and repeat the procedure in **A.3.2**a) to **A.3.2**g) until the installation is proved sound and no discernible pressure drop is recorded.

A.3.3 *Procedure for service and/or installation pipework to operate at 37 mbar for propane or 28 mbar for butane*

a) Ensure that gas appliances are disconnected or are positively isolated by closing their gas inlet valve. Cap or plug all open ends.

b) Connect an in-line test tee. Attach a "U" gauge to the test tee.

c) Inject air or an inert gas into the system until the "U" gauge registers 45 mbar.

d) Isolate the pressurizing source.

e) Leave for at least 5 minutes to allow the temperature in the system to stabilize.

f) Note the "U" gauge reading.

g) Leave for 2 minutes.

h) Note the "U" gauge reading. The pipework is considered sound if there is no discernible pressure drop from that of **A.3.3**f). If the pressure has fallen, examine the entire installation and check each joint with leak detection fluid to locate the source of leakage.

i) Eliminate the leak and repeat the procedure in **A.3.3**c) to **A.3.3**h) until the installation is proved sound and no discernible pressure drop is recorded.

A.3.4 *Final test stage*

Once the entire pipework system has been proved sound under air in accordance with **A.3.2** or **A.3.3**, appliances can be connected or turned on at their appliance isolation valves, the system purged of air and charged with LPG in preparation for a soundness test under LPG pressure (see **A.4.4**).

A.4 Test method for soundness testing with LPG

A.4.1 *General*

Before testing the entire installation for soundness with LPG, a let-by test as given in **A.4.2** should be carried out.

A.4.2 *Let-by test of the cylinder or tank valve*

A.4.2.1 *Principle*

The valve to be tested for let-by should be that valve which is used to isolate the pipework from the upstream higher pressure pipework when tested for soundness in accordance with **A.4.4**. This is to ensure that let-by will not mask any leakage from fittings downstream.

A.4.2.2 *Let-by test of entire installation*

A.4.2.2.1 *Preparation*

Ensure that all appliance isolation valves are turned off and the LPG supply is isolated at the cylinder/tank valve (or whichever valve is to be used during the soundness test). This will be referred to in this procedure as the supply control valve.

A.4.2.2.2 *Procedure*

Carry out the following stages:

a) connect an in-line test tee in the section of pipework downstream of the supply control valve and final stage regulator. Attach a "U" gauge;

b) gradually open the supply control valve until the regulators lock up (normally at 45–50 mbar for a 37 mbar regulator);

c) close the supply control valve;

d) open one appliance isolation valve and light a burner and note carefully the drop in pressure in the "U" gauge. When the pressure has dropped to about 5 mbar, close the appliance burner tap and its isolation valve;

NOTE 1 If there is an under pressure shut-off (UPSO) downstream of the supply control valve, this will close as the pressure falls. In this case, once the pressure has been reduced to about 5 mbar as in **A.4.2.2.2**d), operate the UPSO reset to release the trapped upstream pressure and then allow it to reshut. There may be a small sudden rise in the "U" gauge reading as the upstream pressure is released into the downstream pipework.

e) wait for at least 5 minutes for temperature stabilization, and record the "U" gauge reading;

f) after a further 2 minutes observe the "U" gauge reading and record it. If there is no discernible pressure rise "no let-by" can be recorded for the supply control valve.

NOTE 2 If the procedure in **A.4.2.2.2** Note 1 has been necessary, the UPSO reset will need to be operated again after the 2 minute period, and before recording the second "U" gauge reading.

A rise in pressure will indicate either:

- the gas temperature has risen during the test; or
- the supply control valve is letting-by.

If a gas temperature rise is suspected, repeat the test procedures given in **A.4.2.2.2**b) to **A.4.2.2.2**f).

NOTE 3 For cylinder installations using high pressure hoses between the cylinder valve and regulator where the cylinder valve is the only form of supply control valve, it may be necessary to install an additional supply control valve upstream of the regulator if a rise in pressure is recorded due to hose relaxation. This valve may be either left in place once the let-by and soundness tests are completed, or removed and any joints made after the soundness test checked with leak detection fluid.

A.4.2.3 *Let-by test of service pipework only (procedure avoiding the need to enter premises)*

A.4.2.3.1 *Preparation*

Close the emergency control at the premises, and the tank or cylinder valve or whichever valve will be used for the subsequent soundness test. This will be referred to in this procedure as a supply control valve.

A.4.2.3.2 *Procedure*

Carry out the following stages:

a) connect an in-line test tee in the section of pipework between the supply control valve and emergency control. Attach a "U" gauge (low pressure) or a Bourdon gauge (intermediate pressure);

b) gradually open the supply control valve until the regulators lock up;

c) close the supply control valve;

d) release gas slowly to the open air via the test tee connected to a gas torch at the end of a length of LPG hose or other safe means. When the pressure has dropped to about 5 mbar (low pressure) or 100 mbar gauge (intermediate pressure), shut off the release;

NOTE 1 If there is an under pressure shut-off (UPSO) downstream of the supply control valve, this will close as the pressure falls. In this case, once the pressure has been reduced to about 5 mbar (low pressure) or 100 mbar gauge (intermediate pressure) as in **A.4.2.3.2** d), operate the UPSO reset to release the trapped upstream pressure and then allow it to re-shut. There may be a small sudden rise in the "U" gauge reading as the upstream pressure is released into the downstream pipework.

e) wait for at least 5 minutes for temperature stabilization, and record the "U" gauge reading;

f) after a further 2 minutes observe the "U" gauge reading and record it. If there is no discernible pressure rise "no let-by" can be recorded for the supply control valve.

NOTE 2 If the procedure in **A.4.2.3.2**. Note 1 has been necessary, the UPSO reset will need to be operated again after the 2 minute period and before recording the second "U" gauge reading.

A rise in pressure will indicate either:

- the gas temperature has risen during the test; or
- the supply control valve is letting-by.

If a gas temperature rise is suspected, repeat the test procedures given in **A.4.2.3.2**b) to **A.4.2.3.2**f).

If a supply control valve is letting-by, the fault needs to be rectified or the valve changed and the let-by test repeated to prove no let-by before proceeding with the soundness test. If this is a cylinder outlet valve the cylinder should be changed and the supplier should be notified of the fault for collection and rectification. On no account should anyone else attempt to remove or dismantle a cylinder valve.

NOTE 3 Installations fed from two or more cylinders may be tested for let-by through all the cylinder outlets simultaneously i.e. all valves closed.

A.4.3 *Soundness test procedure for entire system using propane or butane for cylinder installations, and for bulk tank installations using propane where service pipework operates at 37 mbar*

A.4.3.1 *Principle*

This procedure tests the entire pipework system from cylinder or tank outlet valve up to and including the appliances.

The procedure is suitable for all cylinder installations and also bulk propane tank installations if the final stage regulator is located at the tank so that the service pipework operates at 37 mbar and the total service pipework is no longer than 10 m. See Figure A.1, Figure A.2, Figure A.3 and Figure A.4.

The procedure tests the system including the appliances first but it is permissible to test the pipework only first as given in **A.4.4.3**f) and **A.4.4.3**g) if this is seen as more convenient.

A.4.3.2 *Preparation*

Carry out a let-by test on the cylinder valve(s) or tank as given in **A.4.3.2**.

Ensure that all appliance isolation valves are open, cooker hot-plate/oven taps and all other appliance burner control taps are shut, and the LPG supply side is isolated by closing the cylinder valve(s) or tank valve.

On cookers with a fold-down lid, the lid should be raised to a fully open position during the soundness test so that any safety shut-off valves on the supply to the hot plate taps are open.

A.4.3.3 *Procedure*

Carry out the following stages:

a) connect a "U" gauge to a permanent in-line test tee or where necessary fit a suitable test tee in the pipework for this purpose;

b) open a cylinder valve or the tank outlet valve to re-establish the gas supply until lock up pressure is achieved. Close the cylinder or tank valve;

c) wait for at least 5 minutes for temperature stabilization.

For small installations the pressure may fall during this time due to allowable appliance leakage. If the pressure falls below the initial test pressure required by **A.4.4.3**d) repeat **A.4.4.3**b) and **A.4.4.3**c) but reduce the 5 minutes to 2 minutes;

d) light a burner on one appliance and allow the pressure to drop to 30 mbar propane or 20 mbar butane and close the appliance burner control tap. Record immediately the "U" gauge reading.

The lowering of the pressure is necessary to ensure that the locked up high pressure in the system upstream of the regulator is released into the piping downstream and this high pressure section can then be included in the test;

e) wait a further 2 minutes and again record the "U" gauge reading;

f) if a discernible pressure drop occurs or there is a smell of gas, isolate the appliances by closing their isolation valves and repeat **A.4.4.3**b) to **A.4.4.3**e). This will test just the pipework and only "no discernible pressure drop" is acceptable (see **A.1.1** and **A.1.2**);

NOTE 1 For this test the test tee needs to be in the pipework section under test.

g) if a discernible pressure drop or its equivalent leak-rate still persists or there is a smell of gas, leak-test all visible joints with leak detection fluid or a suitable gas detector and repair as necessary. Repeat steps **A.4.4.3**b) to **A.4.4.3**e) to prove pipework sound;

h) after proving the pipework sound, repeat steps **A.4.4.3**b) to **A.4.4.3**e) with appliance isolation valves open to include the appliances. A pressure drop is acceptable provided it does not exceed the values given in Table A.1 or Table A.2 for the relevant type of installation and there is no smell of gas;

NOTE 2 Appliance standards for practical reasons permit a very small leakage, which may cause the pressure drop observed in the first test particularly if the internal volume of pipework and appliances is small.

i) if the system pressure drop exceeds that permitted, repeat steps **A.4.4.3**b) to **A.4.4.3**e) but with only one appliance isolation valve open and repeat for each appliance in turn to check whether the cause is one particular appliance. Rectify the fault(s) if possible, or seek advice from the appliance manufacturer(s). Repeat **A.4.4.3**b) to **A.4.4.3**e) to prove the installation acceptable;

j) after proving the installation acceptable, release the system pressure by lighting a burner. Remove the test tee if it is a temporary fitting and reconnect the pipework. Seal off the test tee if it is a permanent fitting;

k) re-establish the gas supply and test all joints in the high pressure section and any joints made after the soundness tests with leak detection fluid or a suitable gas detector. Rectify leaks if found;

l) recommission the installation.

A.4.4 *Soundness test using propane for bulk tank installation pipework, from a control valve downstream of the final regulator, to connected appliances operating at 37 mbar*

A.4.4.1 *Principle*

This procedure will test pipework and appliances beyond the final regulator using a convenient supply control valve. Since no regulator is in this part of the system the test can be carried out at normal operating pressure.

This procedure is particularly suitable for soundness testing installation pipework alone where the emergency control is downstream of the final regulator, as shown in Figure A.5.

This procedure tests the system including the appliances first but it is permissible to test just the pipework first in accordance with **A.4.4.3** f) and **A.4.4.3** g) if this is more convenient for the installer.

A.4.4.2 *Preparation*

Carry out a let-by test of the supply control valve as given in **A.4.3.2**.

Ensure that all appliance isolation valves are open but cooker hot-plate/oven taps and all other appliance burner control taps are shut and close the intended supply control valve. All intermediate valves should be open.

On cookers with fold-down lids, the lids should be raised to a fully open position during the soundness test so that any safety shut-off valves on the supply to the hot-plate taps are open.

A.4.4.3 *Procedure*

Carry out the following stages:

a) connect a "U" gauge to an in-line test tee or to an appliance injector or where necessary fit a suitable test tee in the pipework for this purpose;

b) open the supply control valve until lock up pressure is obtained. (Remember to open the appliance tap if the "U" gauge is connected to its injector.) Close the supply control valve;

c) wait for at least 5 minutes for temperature stabilization.

For small installations the pressure may fall during this time due to allowable appliance leakage. If the pressure falls below the initial test pressure required by **A.4.4.3**d), repeat **A.4.4.3**b) and **A.4.4.3**c) but reduce the 5 minutes to 2 minutes;

d) light a burner on an appliance and allow the pressure to fall to 30 mbar and then close the appliance tap. Record immediately the "U" gauge reading;

e) wait for a further 2 minutes and record the "U" gauge reading. There should be no discernible pressure drop;

f) if a discernible pressure drop occurs or there is a smell of gas, isolate the appliances by closing their isolation valves and repeat **A.4.4.3**b) to **A.4.4.3**e). This will test just the pipework and only "no discernible pressure" drop is acceptable;

NOTE 1 For this test the test tee needs to be in the pipework section under test.

g) if a discernible pressure drop or its equivalent leak-rate still persists or there is a smell of gas, leak-test all visible joints with leak detection fluid or a suitable gas detector and repair as necessary. Repeat **A.4.4.3**b) to**A.4.4.3**e) to prove pipework sound;

h) after proving the pipework sound, repeat **A.4.4.3**b) to **A.4.4.3**e) with appliance isolation valves open to include the appliances. A pressure drop is acceptable provided it does not exceed the values given in Table A.1 for the relevant type of installation and there is no smell of gas;

NOTE 2 Appliance standards for practical reasons permit a very small leakage, which may cause the pressure drop observed in the first test particularly if the internal volume of pipework and appliances is small.

i) if the system pressure drop exceeds that permitted, repeat **A.4.4.3**b) to **A.4.4.3**e) but with only one appliance isolation valve open and repeat for each appliance in turn to check whether the cause is one particular appliance. Rectify the fault(s) if possible or seek advice from the manufacturer(s). Repeat **A.4.4.3**b) to **A.4.4.3**e) to prove the installation acceptable;

j) after proving the installation acceptable, release the system pressure by lighting a burner. Remove the test tee if it is a temporary fitting and reconnect pipework. Seal off the test tee if it is a permanent fitting;

k) re-establish the gas supply and test any joints made after the soundness tests with leak detection fluid or a suitable gas detector. Rectify leaks if found;

l) recommission the installation.

A.5 Test method for soundness testing using propane for service pipework from the bulk tank outlet to the emergency control at the premises

A.5.1 *Principle*

This procedure involves the soundness testing of the service pipework alone, which includes the short high pressure connection from the tank outlet valve to the regulator(s) at the tank, and pipework from there up to the emergency control valve at the premises, or second stage regulator if the emergency control is adjacent but upstream. See Figure A.4 and Figure A.5.

A.5.2 *Preparation*

Although not part of the test, appliance control valves and cooker hot-plate/oven taps should all be turned off at the user taps and users informed not to try to use them until the tests have been completed.

Carry out a let-by test on the tank outlet valve as given in **A.4.2.3**.

A.5.3 *Procedure*

Carry out the following stages:

a) connect a "U" gauge (low pressure) or a pressure gauge (intermediate pressure) to a permanent in-line test tee or fit a suitable test tee for this purpose. If a Bourdon type gauge is used, the dial should be not less than 150 mm diameter and the range should be such that the test pressure is over half full-scale;

b) close the emergency control or other downstream valve up to which the soundness test will apply;

c) open the tank outlet valve to charge the service pipework up to lock up pressure;

d) close the tank outlet valve and slowly release gas in a safe manner through an appropriate fitting e.g. a test tee connected to a gas torch at the end of a length of LPG hose, until the pressure is 30 mbar (low pressure) or 80 % of the normal operating pressure (intermediate pressure). (See **A.5.3** Note 1.) This will ensure that the tank pressure locked upstream of the first stage regulator is released into the pipework downstream and this high pressure section will then be included in the test;

NOTE 1 It is essential that this release is in the open air.

e) leave for at least 5 minutes for temperature stabilization. Record the pressure;

f) wait for a further 2 minutes (low pressure) or 15 minutes (intermediate pressure) and again record the pressure. There should be no discernible pressure drop (see **A.1.1** and **A.1.2**);

g) if a pressure drop occurs or if there is a smell of gas, re-pressurize the system and leak test all visible joints with leak detection fluid or a suitable gas detector and repair the source of leak. Repeat **A.5.3**a) to **A.5.3**g) to confirm soundness;

NOTE 2 If the downstream valve is downstream of the second stage regulator (see the emergency control positions in Figure A.5), then a pressure drop may also be caused by let-by of that regulator which should remain in lock up during the test. If this fault occurs the regulator will need to be exchanged or repaired.

h) joints in service pipework between a final stage regulator at the premises and the emergency control valve for installations as in Figure A.5, or between the emergency control and the second stage regulator (see Figure A.5 alternative position for the emergency control), should be tested at the lock up pressure with leak detection fluid or a suitable gas detector and repaired if necessary;

i) seal the test tee if it is a permanent fitting, or remove it if it is temporary and reconnect the pipework;

j) re-establish the gas supply and test all joints in the short high pressure section upstream of the first stage regulator and all other joints made after the soundness test, with leak detection fluid or a suitable gas detector. Rectify leaks if found;

k) recommission the installation.

Table A.1 — Permissible pressure drop for test with appliances connected and LPG supplied by cylinder(s) or bulk tank installation pipework

Dwelling	Volume of installation	Permissible pressure drop			
		Initial Test Pressure			
		37 mbar	30 mbar	28 mbar	20 mbar
		Leak-rate 2.5 cm^3/min	Leak-rate 2.0 cm^3/min	Leak-rate 2.0 cm^3/min	Leak-rate 1.3 cm^3/min
		mbar drop in 2 minutes			
Residential park home	0.0030 m^3	2.0	1.5	1.5	1.0
Permanent or small commercial premises (without meter)	0.0039 m^3	1.5	1.0	1.0	0.5
Permanent or small commercial premises (with meter)	0.0109 m^3 (including meter vol)	0.5	0.4	0.4	0.3

Table A.2 — Permissible pressure drop for test with appliances connected and propane supplied from a bulk tank

Dwelling	Volume incl. up to 10 m service pipework	Permissible pressure drop	
		Initial test pressure	
		37 mbar	30 mbar
		Leak-rate 2.5 cm^3/min	Leak-rate 2.5 cm^3/min
	m^3	mbar drop in 2 minutes	
Permanent/dom. or small commercial premises	0.0090	0.6	0.5
Permanent/dom. or small commercial premises	0.016(including meter vol)	0.3	0.3
Residential park home	0.008	0.7	0.5

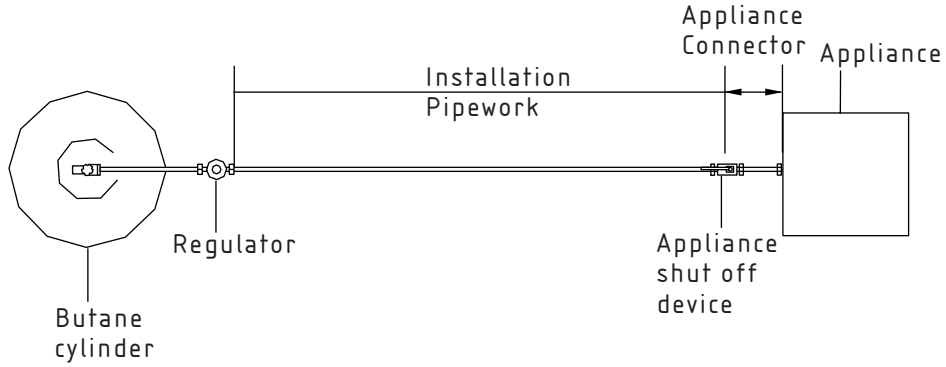


Figure A.1 — Butane cylinder installations

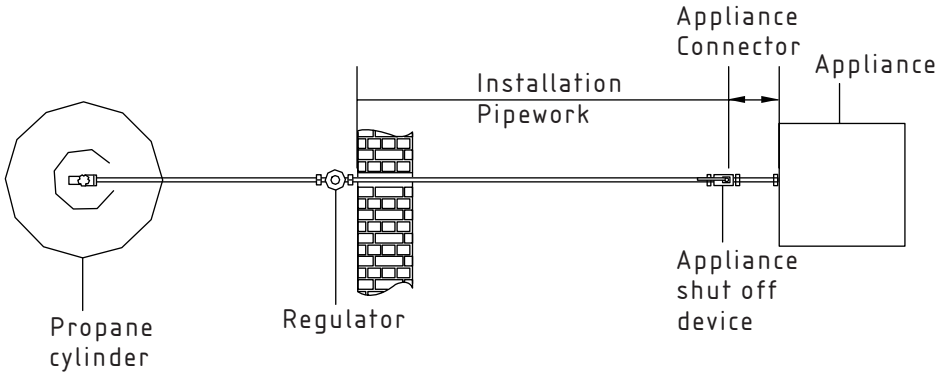


Figure A.2 — Propane cylinder installations

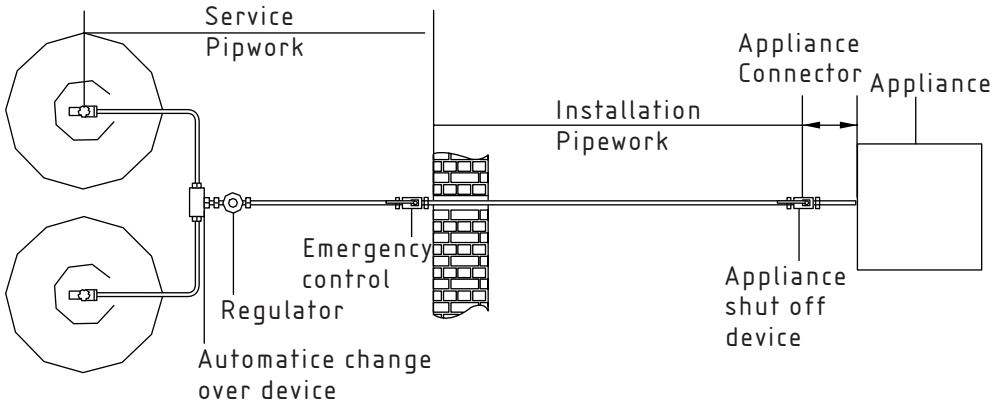


Figure A.3 — Multiple propane cylinder installations

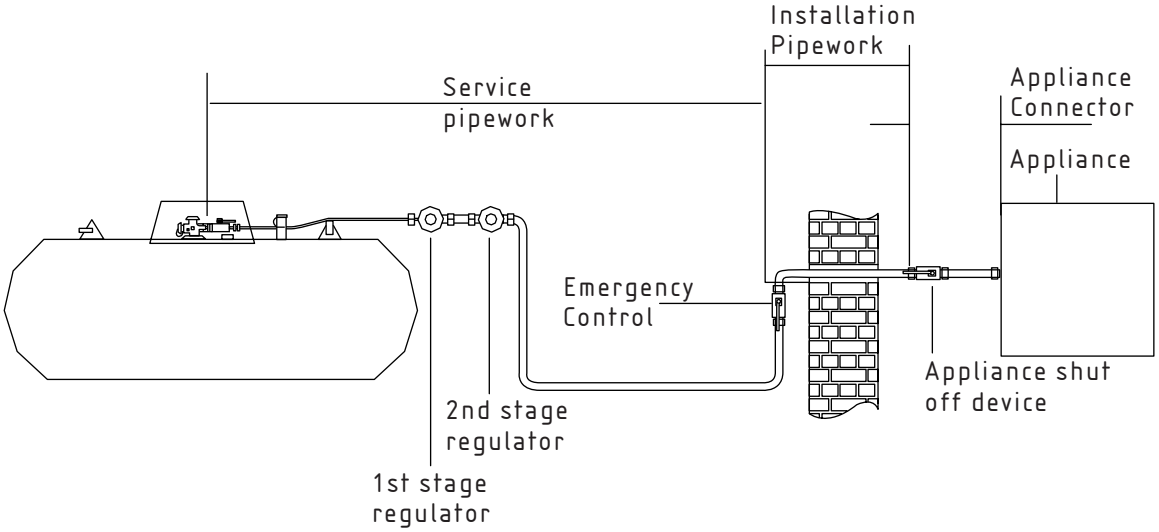


Figure A.4 — Bulk tank installations (service pipework at low pressure)

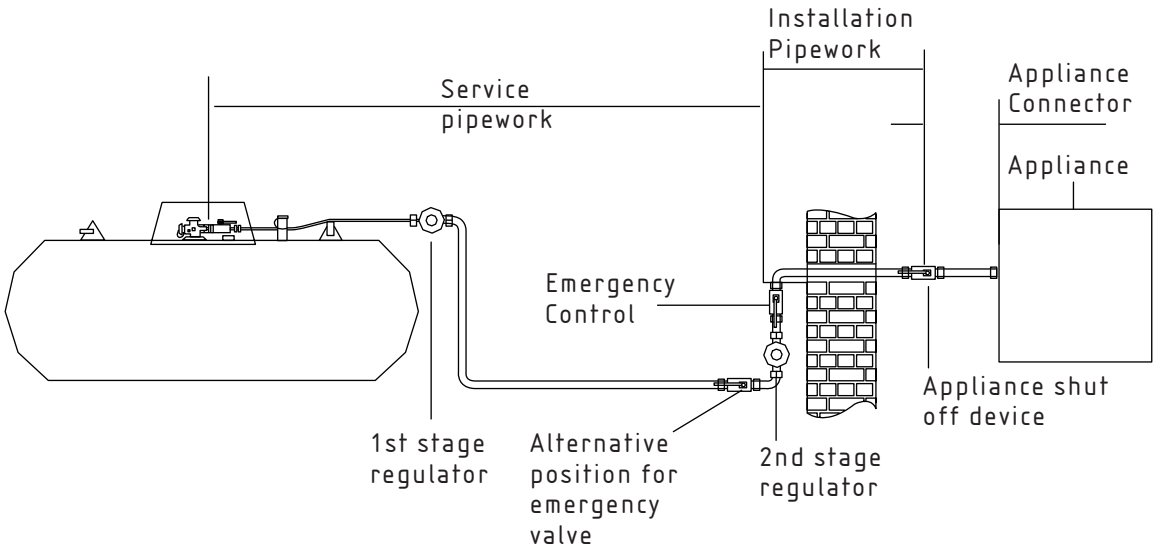


Figure A.5 — Bulk tank installations (service pipework at intermediate pressure)

Annex B (informative)
Guide for sizing gas supply pipes

B.1 When deciding on the correct size of gas pipes for an internal installation, it is recommended practice to allow a maximum pressure loss of 2.5 mbar between the pressure regulator outlet and the appliance connection points. The size of the pipes selected should be of sufficient diameter to supply all the appliances on the installation when they are used at the maximum gas rate. Figure B.1 gives an example of a typical copper tube installation showing the lengths of pipes and the gas rates of the appliances. The pipes have been sized using Table 3 and the results are shown in Table B.2. When sizing pipes, it is essential that consideration is given to the permissible pressure loss in each section of the installation.

B.2 For example, in Figure B.1 the pressure loss between the pressure regulator outlet and the appliance connections should not exceed 2.5 mbar. The service pipework has been sized to give a maximum pressure drop of 0.5 mbar, therefore the maximum allowable pressure drop in the installation pipework is 2.0 mbar.

B.3 In Figure B.1 the installation pipework A to H is made up of four sections of pipe, A–B, B–D, D–F and F–H. Each section carries a different gas rate and needs to be sized separately. If A to H is to have a pressure loss of not more than 2.0 mbar, then the pressure losses in each of the four sections should be approximately 0.5 mbar. So A–B, B–D, D–F and F–H should each be sized to give a pressure loss of approximately 0.5 mbar.

Table B.1 gives typical appliance gas rates.

The table of discharges in a straight horizontal pipe given in Table 3 only allows for pressure losses of 2.5 mbar. However pressure loss is proportional to length, so if the pipe size selected in Table 3 is five times longer than required, the pressure loss on the actual length will be 0.5 mbar.

EXAMPLE

Consider length D–F as given in Figure B.1. D–F has a length of 1.2 m and is to carry a gas rate of 1.0 m^3/h: it should have a pressure loss of 0.5 mbar maximum.

However, a pressure loss of 0.5 mbar in a length of 1.2 m equals (5 × 0.5) = 2.5 mbar in (5 × 1.2 m) = 6 m.

In Table 2, look up the column under 6 m, for a discharge of 1.0 m^3/h and find:

10 mm = 0.57 m^3/h

15 mm = 1.01 m^3/h

22 mm = 5.21 m^3/h

The first size, 10 mm, would give a lower flow rate than is required. The 15 mm would carry the 1.0 m^3/h of gas with slightly less than 0.5 mbar pressure loss but would not allow for appliances to be added to the installation at a later date, if required. The 22 mm would carry the 1.0 m^3/h of gas with little pressure loss and could allow appliances to be added at a later date. This is the size to be used.

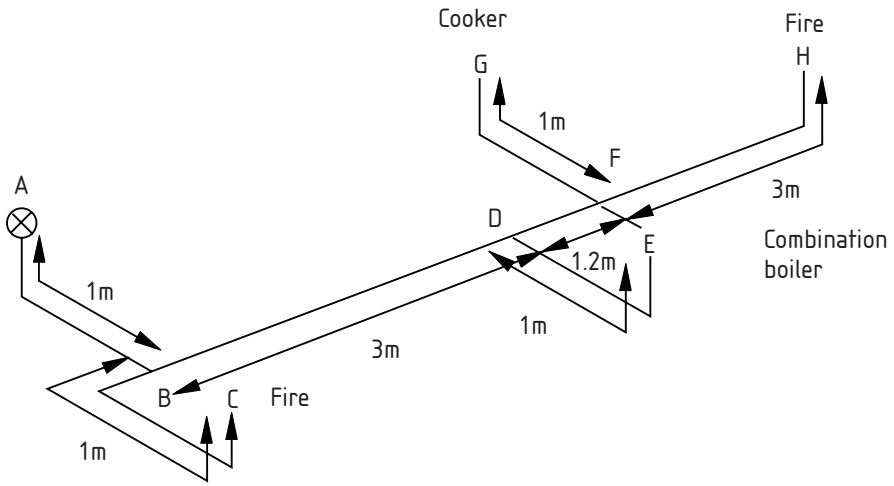


Figure B.1 — Example calculation

Table B.1 — Typical appliance gas rates

Appliance	Gas rate(typical) m^3/h
Combination boiler	1.1
Cooker	0.5
Gas fire	0.5

Table B.2 — Sizing results

Pipe section (see Figure B.1)	Gas rate	Pipe length	Equivalent length fitting[a]		Total length	Pipe diameter[b]
			Type	Equivalent length		
	m^3/h	m		m	m	mm
A–B	2.6	1	elbow tee	0.6 0.6	2.2	22
B–C	0.5	1	two elbows	1.2	2.2	10
B–D	2.1	3	—	—	3	22
D–E	1.1	1	tee elbow	0.6 0.6	2.2	22
D–F	1.0	1.2	—	—	1.2	22
F–G	0.5	1	tee elbow	0.6 0.6	2.2	15
F–H	0.5	3	elbow	0.6	3.6	15

[a] Most appliances have horizontal connections, so in practice an additional elbow is required at each point.
[b] Copper tube in accordance with BS EN 1057.

Annex C (informative)
Model emergency action notice or leaflet for users of LPG

The following is an example of an emergency action notice.

NOTE Typically, capital letters are used where indicated and the colour red is used for words and phrases marked with an asterisk to reinforce the importance of these words.

EMERGENCY ACTION PROCEDURES

In the event of **GAS LEAKAGE***:

NEVER operate electrical switches
NEVER look for a leak with a naked flame
NEVER enter basements

CALL the gas supplier and consider calling the fire brigade. Wait outside.

If safe to do so:

— Extinguish all naked flames.
— Turn off gas supply at cylinders.
— Open doors and windows.

DO NOT turn on the gas supply until it has been made safe to do so by a qualified person.

In the event of **FIRE***

— Call the fire brigade immediately and inform them that LPG cylinders are on the premises.
— Turn off gas supply at cylinders, if practical and safe to do so.
— Do not go near cylinders in the vicinity of the fire.

DO NOT turn on the gas supply until it has been made safe to do so by a qualified person.

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