BS 6891:2015

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Specification for the installation and maintenance of low pressure gas installation pipework of up to 35 mm (R1¼) on premises

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2015. It was prepared by Panel GSE/30/-/3, *Domestic installation pipes*, under the authority of Technical Committee GSE/30, *Gas Installations (1st, 2nd and 3rd family gases)*. A list of organizations represented on this committee can be obtained on request to its secretary.

NOTE 1 The standard now covers the main installation requirements for 3rd family gas installations that were previously covered by BS 5482-1.

NOTE 2 The general installation requirements for 3rd family gas installations specified in this standard also apply to gas installations supplied with LPG/air mixtures used in the Channel Islands or the Isle of Man, provided:

- *any gas equipment being installed has been appropriately converted and is suitable for the gas being supplied; and*
- *the requirements of the standard do not conflict with local regulations or authorized local custom and practice.*

Supersession

BS 6891:2015 supersedes BS 6891:2005+A2:2008, which is withdrawn, and partially supersedes BS 5482-1:2005, which is partially withdrawn.

Information about this document

In this revision, the layout of the standard has been modified to follow the systematic approach adopted in other gas installation standards. The revision provides an update of the previous edition and has been updated to reflect changes in installation practice and legislation, and align with other appropriate standards. A number of other safety initiatives have also been included that have not previously been covered elsewhere in detail. The opportunity has also been taken to combine the pipework requirements for 2nd and 3rd family gas (natural gas and LPG) installations into a single standard for use by the gas industry.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Users of this British Standard are advised to consider the desirability of selecting products for which independent quality assurance certification against the appropriate product manufacture standard has been obtained.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in notes in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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

Compliance with this British Standard cannot confer immunity from legal obligations.

Attention is drawn to the following statutory regulations:

- The Gas Safety (Installation and Use) Regulations 1998 [1];
- The Gas Safety (Installation and Use) (Northern Ireland) Regulations 2004 [2];
- The Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) (Isle of Man) Order 1996 [3];
- The Health and Safety (Gas) (Guernsey) Ordinance 2006 [4];
- The Building Regulations 2010 (England and Wales), as amended [5];
- The Building Regulations (Northern Ireland) 2012 [6];
- The Building (Scotland) Regulations 2004, as amended [7];
- The Gas Safety (Management) Regulations 1996 [8];
- The Gas Safety (Management) Regulations (Northern Ireland) 1997 [9].

1 Scope

This British Standard specifies the design, installation, commissioning and maintenance of gas installation pipework carrying 2nd and 3rd family gas of up to 35 mm (R 1¼) on premises, including residential park homes (2nd and 3rd family gas) and caravan holiday homes (2nd family gas) (see Table 1 and examples in Figure 1 to Figure 3; see also Figure 4).

NOTE 1 The principles of the standard can also be applied to the design, installation, commissioning and maintenance of gas installation pipework carrying 1st family gas.

NOTE 2 Annex A gives a method for calculating pipe sizes. Annex B discusses the sulfidation of natural gas installations, while Annex C summarizes the conclusions of a report on gas in intermediate floors. Guidance on determining whether an area can be deemed a "protected area" is given in Annex D. Requirements for LPG final stage regulator and safety devices are specified in Annex E. Annex F discusses the need for gas pipework design and installation for commercial installations to satisfy regulatory requirements regarding explosive atmospheres.

This British Standard is not applicable to:

a) service pipework and distribution systems;

b) pipework contained within an appliance;

c) bulk storage vessels;

d) LPG pipework installed in leisure accommodation vehicles and for accommodation purposes in vehicles in accordance with BS EN 1949;

e) boats, yachts and other vessels;

f) gas pipework supplying or within appliances having their own gas supply, such as mobile heaters; or

g) gas pipework supplying or within catering establishments covered by BS 6173.

Table 1 **Pipework covered by BS 6891**

Gas type	Pipework	Maximum nominal diameter [A]	Nominal operating pressure mbar [B]
2nd family (NG)	Downstream of the primary meter installation, but not downstream of the inlet of any appliance isolation valve or the inlet of the self-sealing connector of any flexible connection	R1¼ steel, DN 35 [A]	21
3rd family (LPG)	Downstream of: • the emergency control valve (ECV) located on the outside of the property where no meter is fitted; or • the outlet of the final regulator where this is located downstream of the ECV; or • the outlet of the final regulator where this is located downstream of any cylinders and there is no ECV; or • the primary meter installation, but not downstream of the inlet of any appliance isolation valve or the inlet of the self-sealing connector of any flexible connection.	R1¼ steel, DN 35 [A]	37 (propane) 28 (butane)

[A] Dependent upon material type.

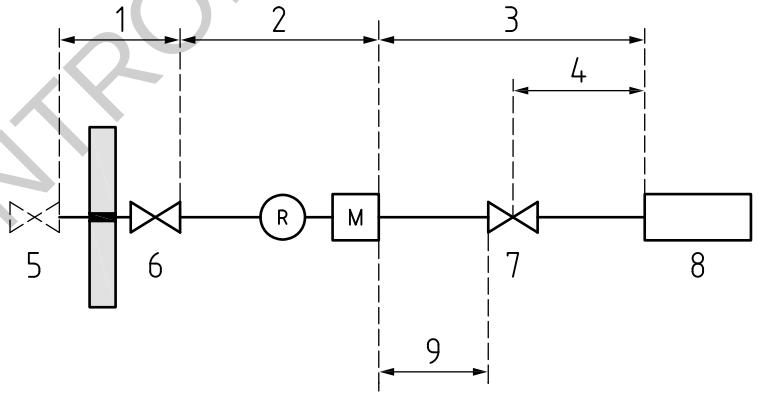
[B] 1 bar = 105 N/m^2 = 100 kPa.

NOTE Unless stated otherwise:

a) *the diameter for pliable corrugated (stainless-steel) tubing refers to the inside diameter; and*

b) *the diameter for carbon, stainless-steel tubing, copper and polyethylene (PE) refers to the outside diameter.*

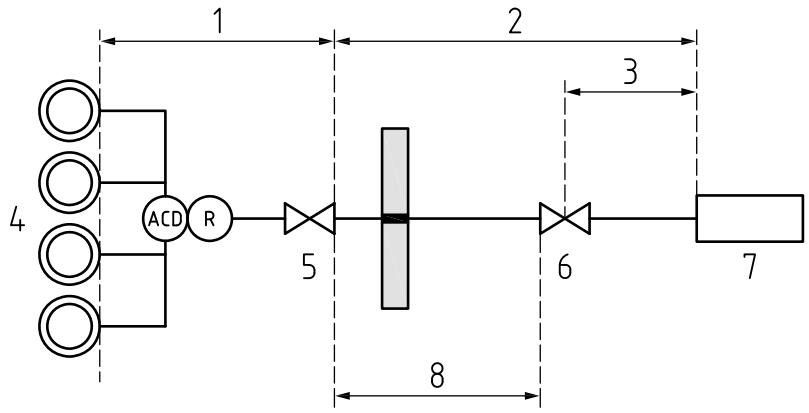
Figure 1 **2nd family gas installation with an internal meter**



Key

1 Service pipe
2 Primary meter installation
3 Installation pipework
4 Appliance connector
5 Service isolation valve (where fitted)
6 Emergency control valve
7 Appliance isolation valve
8 Appliance
9 Part of installation within the scope of BS 6891
R Regulator
M Meter

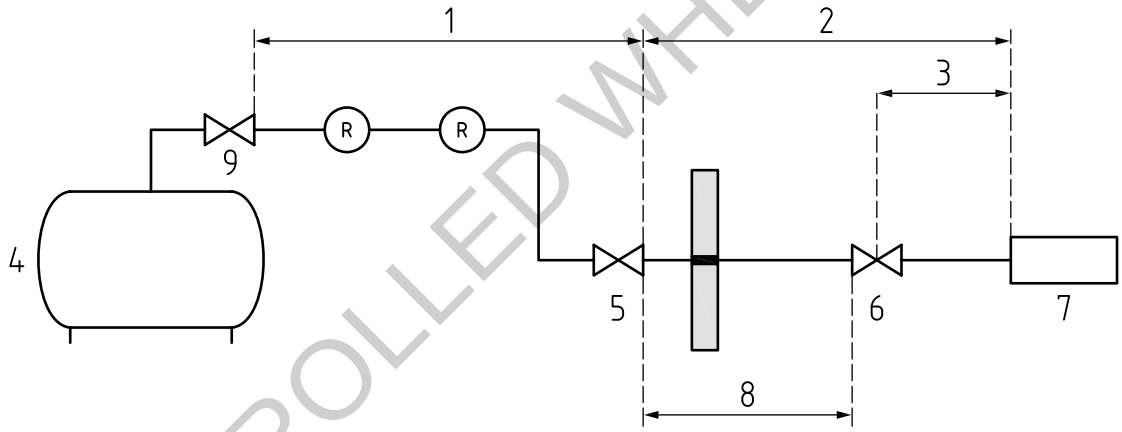
Figure 2 **3rd family gas installation with cylinders**



Key

1	Service pipework	6	Appliance isolation valve
2	Installation pipework	7	Appliance
3	Appliance connector	8	Part of installation within the scope of BS 6891
4	Cylinders	R	Regulator with over-pressure shut-off
5	Emergency control valve	ACD	Automatic changeover device

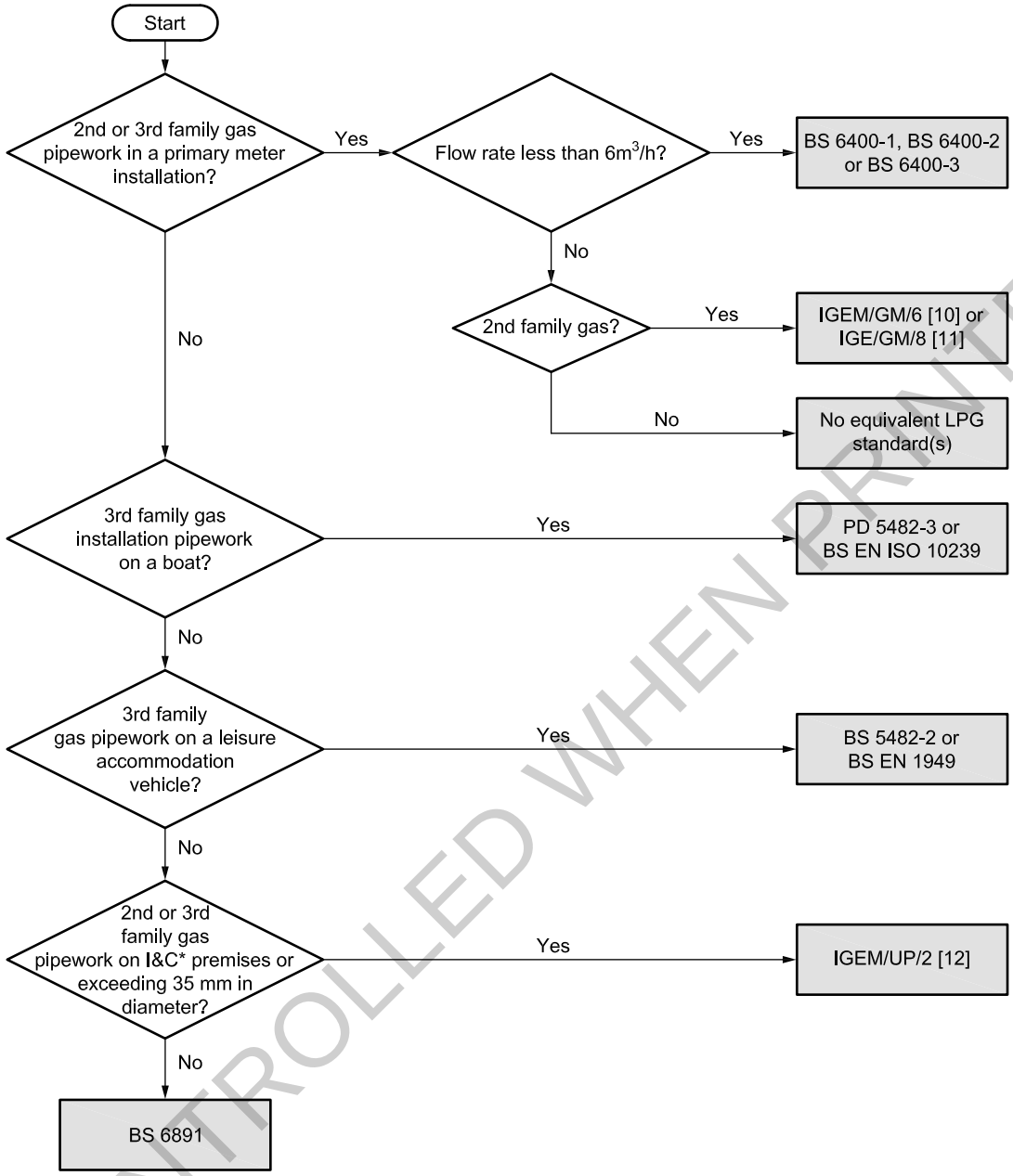
Figure 3 **3rd family gas installation with bulk storage vessels**



Key

1	Service pipework	6	Appliance isolation valve
2	Installation pipework	7	Appliance
3	Appliance connector	8	Part of installation within the scope of BS 6891
4	Bulk storage vessel(s)	9	Vessel isolation valve
5	Emergency control valve	R	Regulator with over-pressure shut-off

Figure 4 **Selection of applicable standard(s) for gas installations**



* Industrial and commercial

NOTE For commercial premises less than 35 mm, IGEM/UP/2 [12] may also be utilized.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 669-1, *Flexible hoses, end fittings and sockets for gas burning appliances – Part 1: Specification for strip-wound metallic flexible hoses, covers, end fittings and sockets for domestic appliances burning 1st and 2nd family gases*

BS 669-2, *Flexible hoses, end fittings and sockets for gas burning appliances – Part 2: Specification for corrugated metallic flexible hoses, covers, end fittings and sockets for catering appliances burning 1st, 2nd and 3rd family gases*

BS 864-2, *Capillary and compression tube fittings of copper and copper alloy – Part 2: Specification for capillary and compression fittings for copper tubes* [1)]

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

BS 3016, *Specification for pressure regulators for liquefied petroleum gases*[1)]

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

BS 4371, *Specification for fibrous gland packings*

BS 5114, *Specification for performance requirements for joints and compression fittings for use with polyethylene pipes*[1)]

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

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

BS 6400-1, *Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m^3/h – Part 1: Low pressure (2nd family gases)*

BS 6400-2, *Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m^3/h – Part 2: Medium pressure (2nd family gases)*

BS 6400-3, *Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m^3/h – Part 3: Low and medium pressure (3rd family gases)* [2)]

BS 6501-1, *Metal hose assemblies – Part 1: Guidance on the construction and use of corrugated hose assemblies*

BS 6956, *Jointing materials and compounds*

BS 7624, *Installation and maintenance of domestic direct gas-fired tumble dryers of up to 6 kW heat input (2nd and 3rd family gases) – Specification*

BS 7671, *Requirements for electrical installations – IET wiring regulations*

BS 7838, *Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50*

BS 8537, *Copper and copper alloys – Plumbing fittings – Specification for press ends of plumbing fittings for use with metallic tubes*

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

BS EN 751-1, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water – Part 1: Anaerobic jointing compounds*

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1) Withdrawn.

2) This standard also gives informative references to BS 6400-3:2007.

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

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

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

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 1254-4, *Copper and copper alloys – Plumbing fittings – Part 4: Fittings combining other end connections with capillary or compression ends*

BS EN 1254-5, *Copper and copper alloys – Plumbing fittings – Part 5: Fittings with short ends for capillary brazing to copper tubes*

BS EN 1555-1, *Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 1: General*

BS EN 1555-2, *Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 2: Pipes*

BS EN 1555-3, *Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 3: Fittings*

BS EN 1775:2007, *Gas supply – Gas pipework for buildings – Maximum operating pressure less than or equal to 5 bar – Functional recommendation*

BS EN 10216-1, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties*

BS EN 10216-2, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

BS EN 10216-5, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes*

BS EN 10217-1, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties*

BS EN 10217-2, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

BS EN 10217-7, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 7: Stainless steel tubes*

BS EN 10226-1, *Pipe threads where pressure tight joints are made on the threads – Part 1: Taper external threads and parallel internal threads – Dimensions, tolerances and designation*

BS EN 10241, *Steel threaded pipe fittings*

BS EN 10242 (all parts), *Threaded pipe fittings in malleable cast iron*

BS EN 10255, *Non-alloy steel tubes suitable for welding and threading – Technical delivery conditions*

BS EN 10312, *Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption – Technical delivery conditions*

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* [3)]

BS EN 13349, *Copper and copper alloys – Pre-insulated copper tubes with solid covering*

BS EN 13785, *Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar, other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures*[3)]

BS EN 13786, *Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures*[3)]

BS EN 15069, *Safety gas connection valves for metal hose assemblies used for the connection of domestic appliances using gaseous fuel*

BS EN 15266, *Stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar*

BS EN 16129, *Pressure regulators, automatic change-over devices, having a maximum regulated pressure of 4 bar, with a maximum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane, and their mixtures*

BS EN 16436-1, *Rubber and plastics hoses, tubing and assemblies for use with propane and butane and their mixture in the vapour phase – Part 1: Hoses and tubings*

BS EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation*

BS EN ISO 10380, *Pipework – Corrugated metal hoses and hose assemblies*

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

3 Terms and definitions

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

3.1 additional emergency control valve (AECV)
valve, not being the emergency control valve (ECV), for shutting off the supply of gas in an emergency, intended for use by a gas consumer

NOTE An AECV might not isolate all the gas consumer's gas installation.

3.2 appliance isolation valve
manual valve to shut off the gas supply to an individual appliance

[3)] Current, though superseded by BS EN 16129.

3.3 basement
part of a building that is partly or wholly underground

NOTE For the purposes of this definition, a room which is built into a hillside is not considered partially underground if at least one (outside) wall of the room is at the same level or at a higher level than the area outside. Additionally, the area outside should not itself be considered to be at a lower level than the wider topography. The ultimate test should be that if an LPG leak occurred in such a room, it could disperse safely to outside (and away) rather than build up either in the room, in other areas of the building or in the immediate area outside the room.

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

3.5 caravan holiday home
transportable leisure accommodation vehicle that does not meet the requirements for construction and use of road vehicles, that retains means for mobility and is for temporary or seasonal occupation

[SOURCE: BS EN 1949:2011+A1:2013, **3.4**]

3.6 compartment floor
floor that separates one dwelling from the rest of the building

3.7 concrete slab
cast in situ concrete which forms the structural load bearing part of a floor

3.8 cylinder
portable and refillable cylinder/vessel containing LPG under pressure

3.9 duct
enclosed space specifically designed and constructed for the passage of building services

3.10 electrofusion joint
joint formed between polyethylene components using fittings which have an integrated electric heating element

[SOURCE: BS EN 1775:2007, **3.4.5**]

3.11 emergency control valve (ECV)
valve, not being an additional emergency control valve (AECV), for shutting off the supply of gas in an emergency, intended for use by a gas consumer and installed at the end of a service or service pipework

3.12 fire 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 fire compartment is included in the compartment where the walls of that compartment extend up to the roof line.

3.13 floor screed
mix of, typically, sand and cement used as a non-structural floor finish/topping

3.14 installation pipework
pipework or fitting from the outlet of the primary meter installation or, for LPG installations where no meter is fitted, the outlet of the ECV to points at which appliances/equipment are to be connected

NOTE This definition varies from that given in the Gas Safety (Installation and Use) Regulations 1998 [1]. This term does not refer to:

- *a service (pipe) or distribution main or other pipeline;*
- *a pipe or fitting forming part of a gas appliance;*
- *a pipe or fitting within a primary meter installation; or*
- *any valve attached to a storage container or cylinder.*

Hereafter referred to as "pipework".

3.15 intermediate floor
floor that separates one living space from another living space in the same dwelling

NOTE This is not a compartment floor that separates one dwelling from another part of the building.

3.16 leisure accommodation vehicle
unit of living accommodation for temporary or seasonal occupation

NOTE Such vehicles might meet the requirements of the Road Vehicles (Construction and Use) Regulations 1986, as amended [13], and include touring caravans, motor caravans and caravan holiday homes.

3.17 limited relief valve
device which is part of the regulator and which limits, in the event of a failure, the pressure rise above a predetermined value without shutting off the flow of gas

3.18 liquefied petroleum gas (LPG)
commercial butane or commercial propane

NOTE BS 4250 specifies requirements for commercial butane and commercial propane.

3.19 LPG supplier
person or organization who provides LPG to a gas consumer, either by means of the filling or refilling of a storage vessel, or in refillable cylinders

3.20 mechanical joint
joint in which gas tightness is achieved by compression with or without a seal and which can be disassembled and reassembled

[SOURCE: BS EN 1775:2007, **3.4.3**]

3.21 meter installation
installation that comprises a primary meter, valves, filter, meter regulator and associated safety devices, pliable connector, interconnecting pipework, fittings and support

NOTE 1 A meter installation commences at the outlet of the ECV. Depending on the type of meter installation it terminates at:

- *the outlet connection of the meter;*
- *the outlet of the meter outlet adaptor if fitted; or*
- *in the case of a semi-concealed meter with a pliable connector downstream of the meter, the outlet of the meter box outlet adaptor.*

[SOURCE: BS 6400-3:2007, **3.23**, modified]

NOTE 2 A typical installation with pipework is shown in Figure 1.

3.22 multi-occupancy building
building that contains multiple domestic dwellings or a building that contains both multiple domestic dwelling(s) and commercial unit(s)

3.23 nominal operating pressure (NOP)
pressure under which the appliance(s) operates in nominal condition when supplied with the corresponding reference gas

3.24 operating pressure
pressure at which a gas system operates under normal conditions

3.25 over-pressure shut-off (OPSO)
shut-off device, triggered by an excess outlet pressure, which causes the complete shut-off of the flow of gas for all values of inlet pressure

NOTE This device is normally an integral part of the regulator. It may also be referred to as a "slam shut valve" or "over-pressure cut-off" (OPCO).

[SOURCE: BS 6400-3:2007, **3.25.1**, modified]

3.26 permanent dwelling
structure of a permanent nature used primarily for domestic purposes

3.27 pliable corrugated (stainless-steel) tubing
tubing of stainless steel, capable of being bent easily by hand a limited number of times and covered with an outer sheath by the manufacturer at the time of production

NOTE The term is sometimes abbreviated to corrugated stainless-steel tubing (CSST) or pliable tubing (PLT). This product should not be confused with the pliable connectors referred to in BS 6400, which are not covered by an outer sheath and have factory-fitted end connections.

3.28 power-floated floor
floor finish formed by powered rotary metal blades passed over a partly cured concrete floor slab to form a monolithic structure, which avoids the need for a separate screed to provide the floor finish

3.29 precast flooring
factory-produced concrete flooring system that provides the structural load bearing part of the floor

EXAMPLES

Concrete plank or concrete beam and block suspended flooring systems.

3.30 press end joint
joint in which tightness is achieved by using an appropriate tool for either compressing a fitting to form the joint or expanding a pipe to enable forming the joint

NOTE Such a joint cannot be disassembled and reused.

3.31 primary meter
meter nearest to and downstream of a service pipe or service pipework for ascertaining the volume of gas supplied through that pipe by a gas supplier

3.32 protected area
ventilated space containing gas pipework, and isolated from other parts of a building within fire-resisting construction, which includes:

a) a common stairway, corridor or lobby that provides an escape route from a building to a place of safety and access for firefighting purposes (referred to

within Building Regulations [5], [6], [7] as a "protected shaft", "protected stairway", "protected corridor/lobby" or "protected zone"); and

b) a service shaft/duct, which can also contain electrical and water services

NOTE Fire-resisting is the ability of a component or construction of a building to satisfy for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476. Additional guidance on determining whether an area can be deemed a "protected area" or otherwise is given in Annex D.

3.33 range-rated appliance
appliance that has the facility for an operative to adjust the heat input of the appliance within a narrow range of minimum and maximum heat inputs stated by the manufacturer to suit the actual heat requirements of the system

NOTE The range between minimum and maximum heat inputs is in the region of 3 kW.

3.34 regulator
device that controls the pressure at its outlet within predetermined parameters

3.35 residential park home
caravan used for permanent residence

NOTE Such caravans do not meet all of the requirements of the Road Vehicles (Construction and Use) Regulations 1986, as amended [13]. These are covered by BS 3632. "Permanent residence" is defined in the Caravan Sites and Control of Development Act 1960 [14] and the Caravans Sites Act 1968 [15].

3.36 service pipe
pipe for distributing gas to premises from a distribution main, being any pipe between the distribution main and the outlet of the first emergency control valve

3.37 service pipework
pipe for supplying gas to premises from a gas storage vessel, being any pipe between the gas storage vessel and the outlet of the ECV

3.38 sleeve
protective pipe forming an annulus embedded in the structure through which pipework can be inserted and withdrawn

3.39 threaded joint
joint in which gas tightness is achieved by metal-to-metal contact within threads with the assistance of a sealant

[SOURCE: BS EN 1775:2007, **3.4.2**]

3.40 under-pressure shut-off (UPSO)
device integral to the regulator, which causes the complete shut-off of the gas flow when the outlet pressure is below a predetermined value

[SOURCE: BS 6400-3:2007, **3.25.2**]

3.41 void
enclosed space not specifically designed for the passage of building services

3.42 variable-rated appliance
appliance that has the facility for an operative to set the heat input of the appliance within a wide range of heat inputs stated by the manufacturer to suit the actual heat requirements of the system

4 Competence

Persons carrying out work that will have an impact on work covered by the scope of this standard shall ensure that they have the competence relevant for the task such as not to compromise the requirements/recommendations of this standard and in particular the safe installation, commissioning and operation of gas equipment.

*COMMENTARY ON CLAUSE **4***

Competence requires sufficient knowledge, practical skill and experience to carry out the job in hand safely, with due regard to good working practice. The installation should also be left in a safe condition for use. Knowledge should be kept up to date with changes in law, technology and safe working practice.

It is a statutory requirement in Great Britain, the Isle of Man, Northern Ireland and Guernsey (see Table 2) that all "gas work" be carried out by a business or self-employed person(s) that is a member of a "class of persons" registered with a registration body which has been approved by an approval body (see Table 2) to operate and maintain such a register.

At the time of publication, the only body with approval to operate and maintain a register of individuals/businesses who are "members of a class of persons" is the Gas Safe Register. Thus, it is essential that all businesses or self-employed gas engineers are registered with the Gas Safe Register.

The qualifications which persons need to have to be deemed competent to carry out gas work are given in Table 3.

Table 2 **Approval bodies and statutory regulations by country/territory**

Country/territory	Approval body	Statutory regulations
Great Britain	Health and Safety Executive (HSE)	Gas Safety (Installation and Use) Regulations 1998 [1]
Isle of Man	Health and Safety at Work Inspectorate (HSWI)	Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) (Isle of Man) Order 1996 [3]
Northern Ireland	Health and Safety Executive Northern Ireland (HSENI)	Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 [2]
Guernsey	Health and Safety Executive for the States of Guernsey [HSE (Guernsey)]	Health and Safety (Gas) (Guernsey) Ordinance 2006 [4]

Table 3 **Competence requirements by country/territory**

Qualifications	Great Britain and Isle of Man	Northern Ireland	Guernsey
Current certificate(s) of competence in the type of gas work to be conducted, issued by an awarding body accredited by the United Kingdom Accreditation Service (UKAS) (ACS certification)	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned in matters of gas safety	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned under the HSC ACoP arrangement [A)] as approved with the registration body	✓	✓	✘
Any other scheme recognized by the gas registration body for registration purposes	✓	✓	✓

[A)] Guidance on the individual competence required for gas work is given in IGEM/IG/1: *Standards of training in gas work* [16].

5 Design and planning

5.1 Exchange of information and time schedule

5.1.1 At the initial stages of building/installation design and planning it shall be verified that the pipework will be adequate for the known requirements.

NOTE Gas pipework design and installation for commercial installations undertaken in accordance with this British Standard need to account for any requirements imposed by DSEAR [17], [18]. Additional information can be found in Annex F.

5.1.2 All necessary information regarding the routing of pipework and positions of valves and termination points to serve the appliances shall be made available by means of drawings, specifications and consultations, as appropriate.

NOTE Any drawings should include:

a) the positions of voids, shafts, ducts and channels when pipework is to be concealed;

b) special requirements of a precautionary nature, e.g. limitations on proximity to other services or effects of differential movement due to the building construction; and

c) sizes, materials and positions of all pipework and fittings.

5.1.3 Any pipework installed shall be tested for gas tightness in accordance with **10.2** before being buried, covered, painted or wrapped.

5.2 Sizing

5.2.1 When designing an installation, the size of all pipework shall be such that the gas is at a suitable pressure at the inlet of any gas appliance to ensure that it meets the required appliance heat input.

Where any sections of the pipework supply gas to multiple appliances, the heat input of all appliances fed by that section of pipework shall be taken into account.

NOTE Annex A gives a method for calculating pipe sizes in a system.

5.2.2 The design maximum pressure loss for all pipework shall not exceed that specified in **5.3.2** or **5.4.2** in the following circumstances:

a) new installations;

b) pipework modification or extension to existing installations;

c) before any new appliance is fitted to a new or existing installation; and

d) increasing any appliance heat input.

NOTE The design pressure loss of existing installations that are not subject to the modifications listed in b), c) or d) should conform to the standard that was applicable at the time of installation, for example previous editions of BS 6891 for natural gas and BS 5482-1 for LPG.

5.2.3 For range-rated appliances, the installer shall use the maximum heat input to ensure the pipework is sized to meet the requirements of **5.2.1** and **5.2.2**.

NOTE For combination boilers where the maximum heat input is different for the hot water and heating modes, the higher of the two heat inputs should be used.

5.2.4 For variable-rated appliances, the installer shall establish the heat input necessary to meet the requirements of the system and shall use this value to ensure the pipework is sized to meet the requirements of **5.2.1** and **5.2.2**.

NOTE For combination boilers where the maximum heat input is different for the hot water and heating modes, the higher of the two heat inputs should be used.

5.3 Natural gas installations

5.3.1 Meter installation

The meter and other meter installation components shall be of sufficient capacity for the installation design load.

NOTE Further information on meter installations is given in BS 6400-1 and BS 6400-2, IGEM/GM/6 [10] or IGE/GM/8 [11], as appropriate.

5.3.2 Pipework

The design pressure loss between the outlet of the primary meter installation and the point to be connected on any appliance inlet shall not exceed 1 mbar at the design installation flow rate (see **5.2.3** and **5.2.4**).

NOTE See Figure 5 for illustrative examples.

5.4 LPG installations

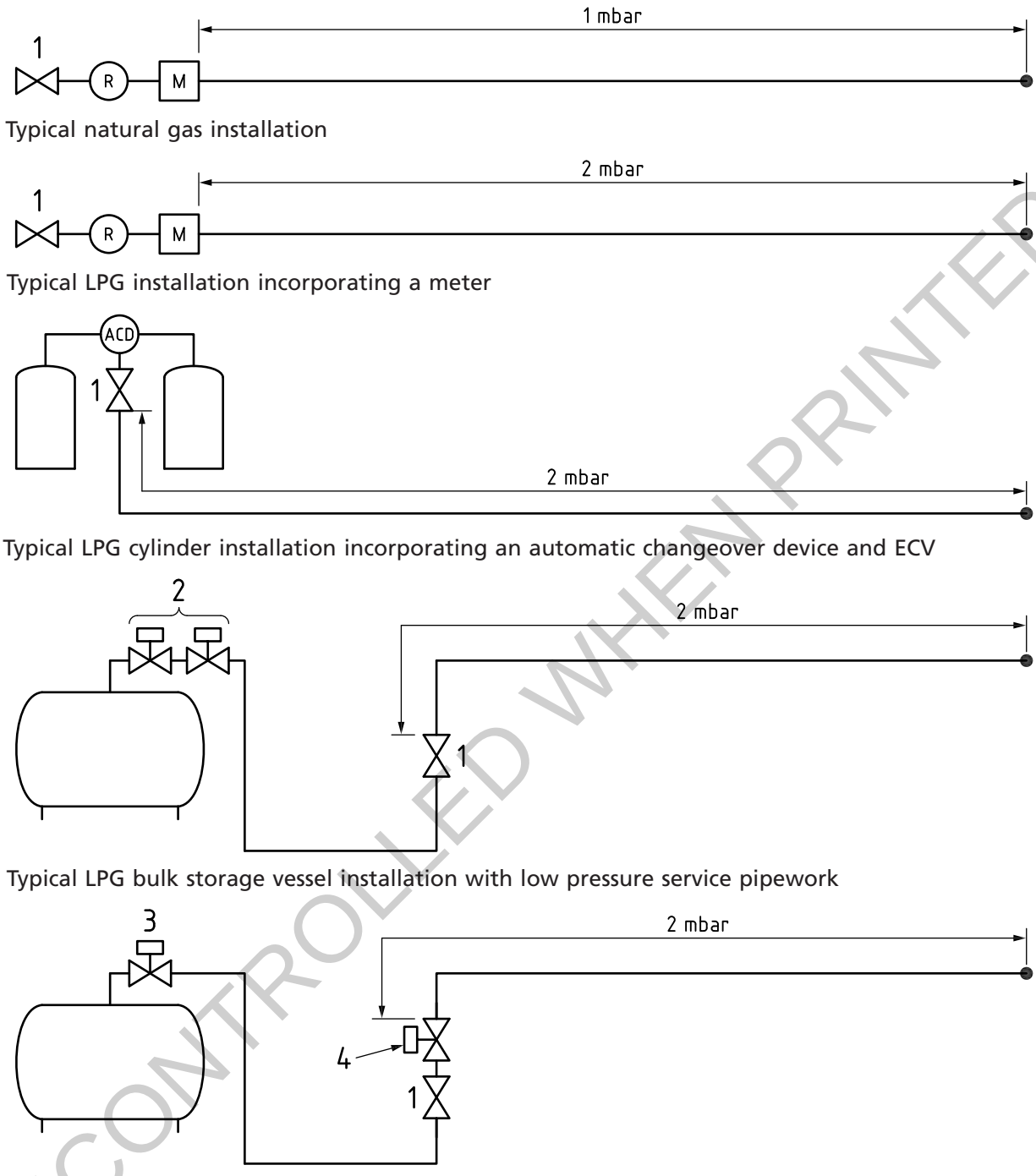
5.4.1 Storage vessels, service pipework, regulators and meter installation

The storage vessel(s), service pipework, regulators, meter (where applicable) and other supply equipment installed shall be of sufficient capacity for the installation.

NOTE Further information on meter installations is given in BS 6400-3. Further information on storage vessel(s), service pipework and regulators (where no meter is fitted) is given in UKLPG Codes of Practice 1 and 22 [19], [20].

Requirements for LPG final stage regulator and safety devices are specified in Annex E.

Figure 5 **Sizing pipework – Design maximum pressure loss for typical installations**



a) Typical natural gas installation

b) Typical LPG installation incorporating a meter

c) Typical LPG cylinder installation incorporating an automatic changeover device and ECV

d) Typical LPG bulk storage vessel installation with low pressure service pipework

e) Typical LPG bulk storage vessel installation with medium pressure service pipework

Key

1 Emergency control valve (ECV)
2 First and final stage regulators (upstream of ECV)
3 First stage regulator (upstream of ECV)
4 Final stage regulator (downstream of ECV)

R Meter regulator
M Meter
• Point to be connected on an appliance
ACD Automatic changeover device (incorporating regulator)

5.4.2 Pipework

The design pressure loss between the outlet of the primary meter installation, or where no meter is installed, the outlet of the ECV or the outlet of the final stage regulator when fitted after the ECV and the point to be connected on any appliance inlet shall not exceed 2 mbar at the design installation flow rate (see **5.2.3** and **5.2.4**).

NOTE See Figure 5 for illustrative examples. For LPG/air installations the typical operating pressure loss allowed for in the design calculations is 2 mbar.

5.5 Purge points

Where it is not possible to purge through an appliance with an open burner, purge points shall be provided to enable the installation to be adequately purged (see IGEM/UP/1 series of standards [21], [22], [23]).

6 Materials and components

*COMMENTARY ON CLAUSE **6***

*When selecting materials for use as pipework, consideration should be given to strength, appearance and the need for protection against corrosion. The Gas Safety (Installation and Use) Regulations 1998 [1] prohibit the installation of lead or lead alloy pipes supplying gas. However, historically, lead pipes were used to install gas meters, and lead alloy pipes (known as lead composition pipes) were installed as pipework and can still be found in old housing stock. Provided this material is in good condition, sound, well-supported and of adequate size, connection can be made to steel or copper pipework using appropriate fittings (see Clause **7**).*

6.1 General

Materials used for pipework and fittings shall conform to **6.2**, **6.3**, **6.4**, **6.5** and/or **6.6**, as appropriate.

6.2 Steel

6.2.1 Steel tubes shall conform to:

- BS EN 10216-1 and BS EN 10217-1 and/or BS EN 10216-2;
- BS EN 10217-2; or
- BS EN 10255.

6.2.2 Rigid stainless-steel tubes shall conform to:

- BS 6362;
- BS EN 10216-5;
- BS EN 10217-7; or
- BS EN 10312.

6.2.3 Pliable corrugated (stainless-steel) tubing shall conform to:

- BS 7838; or
- BS EN 15266.

6.2.4 Steel fittings shall confirm to BS EN 10241.

6.3 Malleable iron and cast copper alloy

Malleable iron and cast copper alloy fittings shall conform to:

- BS 143 and 1256; and/or
- BS EN 10242 (all parts).

6.4 Copper

6.4.1 Copper tube shall conform to:

- BS EN 1057; or
- BS EN 13349.

6.4.2 Capillary and mechanical fittings shall conform to:

- BS EN 1254-1;
- BS EN 1254-2;
- BS EN 1254-4; or
- BS EN 1254-5.

6.4.3 Copper and copper alloy press end connections shall conform to BS 8537, Type 2.

NOTE Sometimes referred to as "press-fit fittings".

*COMMENTARY ON **6.4***

Brazed joints should be made in accordance with BS EN 14324, using BS EN 1044 filler metals.

Soft solder should conform to BS EN 29453.

Sulfidation of the gas supplies can be a problem in some areas of the United Kingdom. See Annex B for further information.

6.5 Polyethylene

6.5.1 Polyethylene tubes shall conform to:

- BS EN 1555-1; or
- BS EN 1555-2,

as appropriate.

6.5.2 Polyethylene fittings shall conform to:

- BS 5114; or
- BS EN 1555-3,

as appropriate.

6.6 Jointing materials and compounds

Jointing materials and compounds shall conform, as appropriate, to the applicable parts of:

- BS 4371;
- BS 6956; or
- BS EN 751,

as appropriate.

*NOTE Fibrous materials such as hemp conforming to BS 4371 should be used with the appropriate jointing compound (see **7.6**).*

6.7 Valves

6.7.1 Valves shall conform, as appropriate, to:

- BS 1552; or
- BS EN 331; or
- PRS1/E [24]; or
- GIS/V7-3 [25].

6.7.2 Lubricants used in valves shall be of a type suitable for use with the gas.

6.7.3 For LPG installations, plug valves shall be spring-loaded.

6.8 Self-sealing sockets

Only self-sealing sockets conforming to BS 669-1, BS 669-2 or BS EN 15069, as appropriate, shall be used for gas installations. These shall be installed in accordance with BS 6172 or BS 7624.

6.9 Flexible hoses, tubing, assemblies and their connections

6.9.1 LPG hoses, tubing and assemblies shall conform to:

- BS 3212; or
- BS 6501-1; or
- BS EN 16436-1; or
- BS EN ISO 10380.

6.9.2 LPG hoses and tubing connections (including nozzles and adaptors) shall conform to:

- BS 3212; or
- BS EN 16129.

6.9.3 Natural gas hoses, tubing and assemblies shall conform to:

- BS 6501-1; or
- BS EN ISO 10380.

7 Jointing

7.1 General

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

7.1.2 All pipework ends shall be square-cut and deburred, as appropriate, and finished joints shall be visually examined for defects.

7.1.3 All joints shall be mechanically strong and gas-tight.

7.2 Capillary fittings

7.2.1 Finished joints shall be visually examined to confirm that the solder has run completely around the joint.

7.2.2 Any flux selected for use shall only remain active during the heating process. All flux residues shall be wiped from the pipework and fittings when the joint has cooled.

7.2.3 It is important that pliable corrugated (stainless-steel) tubing is not contaminated in any way with flux or solder, either internally or externally. Any soldering on adjacent copper pipework shall be completed, and the soldered component thoroughly cleaned of flux, before any connection to pliable corrugated (stainless-steel) tubing is made.

NOTE Copper pipework can be jointed without conventional fittings by the use of purpose-made tools that form the pipework ends in accordance with BS EN 1254-1 or BS EN 1254-5.

7.3 Mechanical joints

7.3.1 Any mechanical joint shall be located in a readily accessible position that allows the fitting to be tightened to make a gas-tight joint.

7.3.2 Union joints shall be of the ground-faced or compression type.

7.4 Press end connections

7.4.1 All press end connections shall be assembled in accordance with the manufacturer's instructions.

7.4.2 The installer shall instruct the gas consumer/responsible person to ensure that the fittings are not painted with oil or solvent-based paints unless otherwise specified in the manufacturer's instructions.

NOTE The yellow colour of the bodies of press end connections should remain visible after installation.

7.5 Pliable corrugated (stainless-steel) tubing and fittings

Pliable corrugated (stainless-steel) tubing and fittings shall be assembled in accordance with the manufacturers' instructions.

7.6 Screwed joints

7.6.1 Threads shall conform to:

- BS 21;
- BS 864-2;
- BS EN 1254-4;
- BS EN 10226-1;
- BS EN ISO 228-1; or
- ISO 7-1.

7.6.2 All threads shall be cleaned prior to the application of any jointing material.

7.6.3 Fibrous materials such as hemp shall not be used on any threaded joint, except in conjunction with jointing compounds for existing long screw back-nut seals.

7.6.4 Jointing compounds and tapes shall conform to BS EN 751-1 (compounds), BS EN 751-2 (anaerobic sealants) or BS EN 751-3 (tapes), as appropriate, and shall be applied in accordance with the manufacturer's instructions.

*COMMENTARY ON **7.6***

When jointing compounds are used they 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 polytetrafluoroethylene (PTFE) materials.

It is important that any cutting oil residue is removed from the inside and outside of the pipework.

7.7 Lead composition pipework

When lead composition pipework is encountered and any connection joint has to be made, then only a soldered cup joint onto copper pipework or a suitable brass union fitting shall be made. Compression fittings designed for jointing water weight lead pipework shall not be used.

7.8 Electrofusion joints

Relevant information shall be obtained from the manufacturer of the PE pipe/fittings.

*NOTE Solvent welding is not acceptable (see **8.15**).*

8 Installation

8.1 General

8.1.1 Where pipework is liable to mechanical damage, it shall be physically protected. While installation work is in progress, precautions shall be taken to prevent the ingress of dirt, water, etc., into pipework.

8.1.2 The bore of any pipework shall not be restricted by kinks, burrs, foreign matter or in any other way.

8.1.3 Pipework shall be installed so as not to impair the structural stability, fire resistance, damp-proof course, or thermal and sound insulation of the building.

8.1.4 Pipework shall be situated such that, in the event of a gas escape, gas is not capable of entering cavities.

8.1.5 Pipework shall not be installed in any location where, if there is a requirement to gain access to the pipe in the future, this could affect the structural stability of the building.

8.1.6 For LPG installations, pipework entries to, and exits from, buildings shall always be above ground.

8.1.7 Pipework shall not be installed in a position where it is likely to be exposed to a corrosive environment.

8.1.8 Pipework and fittings that are considered to be at risk of corrosion and degradation shall either be manufactured from materials that are inherently resistant to corrosion or shall otherwise be suitably protected against corrosion.

NOTE Examples of pipework that is likely to be susceptible to corrosion and degradation are:

- *pipework buried in solid floors (see **8.10**);*
- *pipework buried in walls (see **8.11**); and*
- *buried external pipework (see **8.13**).*

8.1.9 All sections of pipework considered to be at risk of corrosion and degradation shall be protected, including any joints and fittings.

8.1.10 Any factory-finished protection shall be examined for cuts or other defects and made good prior to use. Any damage shall be repaired in accordance with the manufacturer's instructions to give at least the same level of protection that was afforded before the damage. Any onsite protection shall be applied to clean and dry pipework and fittings.

8.1.11 Pipework in fireplace openings shall be factory-finished protected pipe and/or wrapped on site.

8.1.12 Assembled pipework shall be tested for gas tightness in accordance with **10.2** before any additional protection against corrosion and degradation is applied on site.

*COMMENTARY ON **8.1.7** TO **8.1.12***

Factory-finished protected pipe should be used wherever practicable. Factory-finished protection can take the form of pre-insulation coatings, coverings, sheathings, wrapping, dipping, galvanizing or painting.

Where possible, pre-insulation coatings, coverings, sheathings and wrapping should be coloured yellow ochre in accordance with BS 1710:1984, O8 C 35.

Where it is not practicable to use or obtain factory-finished protected pipe, protection should be applied on site and in accordance with manufacturer's instructions where applicable. Where wrapping tape is to be used, the pipework should be clean, dry and applied in accordance with the tape manufacturer's instructions. A minimum 55% overlap should be used to provide a layer of at least double thickness.

Care should be taken to avoid damaging protective coatings during storage, when bending and when installing.

Protection of joints requires special attention; exposed threads are particularly vulnerable to corrosion. Site protection should be suitably selected for the application (for example, to stop the ingress of water) and can be achieved by the application of PVC wrapping tapes, self-bonding silicone tapes, grease-impregnated tape or bituminous paints applied in accordance with manufacturer's instructions where applicable.

Where pliable corrugated (stainless-steel) tube fittings are used in an area considered to be at risk of corrosion and degradation, each fitting should be assembled in accordance with the manufacturer's instructions to ensure a liquid-proof seal is achieved between the factory-applied cover and the wall of the fitting.

Some pre-insulation coatings, coverings, sheathings and wrapping tapes suffer from colour fade and surface cracking due to the effects of ozone or when exposed to direct sunlight or other ultra-violet (UV) sources. Therefore, care should be taken to ensure a suitable material is selected.

Potentially corrosive environments also include coastal areas. Soot and debris in fireplace openings can be highly corrosive.

Copper pipework with soft-soldered capillary joints should not be located where it is liable to be subjected to temperatures in excess of 100 °C.

8.2 Connection to the meter installation

Where the meter is not securely restrained (e.g. by a meter bracket fastened to the floor/wall), the connection to the meter installation shall be in securely-fixed rigid pipework for at least the first 600 mm.

8.3 Safety precautions

8.3.1 Prior to any work being undertaken on the pipework a risk assessment shall be carried out. This shall include:

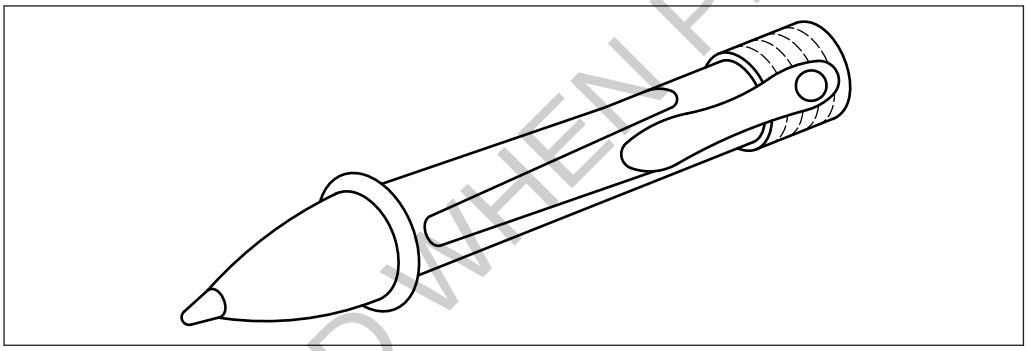
a) risks involved in working on installations that contain fuel gas; and

b) stray electrical currents.

8.3.2 Suitable precautions shall be taken to determine the possibility of stray electrical voltages being present.

NOTE The use of a non-contact voltage detector (single pole) capable of indicating voltages of 50 V or greater (see Figure 6 for an example) on all exposed metalwork in the work area assists in the detection of stray voltage that might be harmful. It should be noted that such voltage detectors are not designed to respond to current flow and should be used in accordance with the manufacturers' instructions. Where any doubt about the electrical installation exists, the advice of a competent electrician should be sought.

Figure 6 **Non-contact voltage detector (single pole) – Example**



8.3.3 Where an installation is temporarily isolated to allow work to be undertaken on it, the risks involved in working on an installation that contains fuel gas shall be assessed.

8.3.4 During any work that necessitates removal of a meter, breaking into the gas supply, or connection or disconnection of any metal pipework, a temporary continuity bond shall 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 continuity bond shall always be used irrespective of any permanent protective bonding that is installed (see Figure 7).

*COMMENTARY ON **8.3.4***

A recommended temporary continuity bond comprises at least 1.2 m of single-core insulated flexible cable or equivalent of at least 250 V ac rating. The cable should have a cross-sectional area of not less than 10 mm^2 and be of multi-strand flexible construction, generally in accordance with BS 6004, BS 6007 or BS 6231, and with a robust clip or clamp firmly attached at each end.

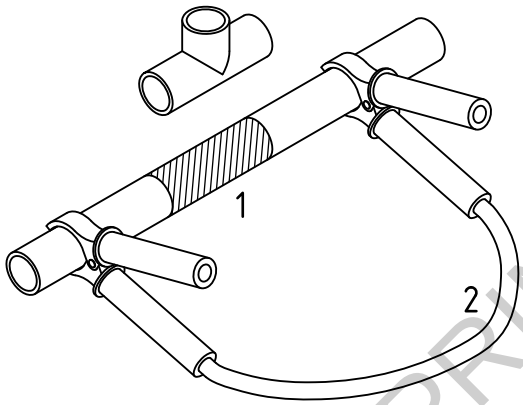
The recommended disconnection procedure is as follows.

a) Isolate the electrical connection of associated gas appliances from the electricity supply.

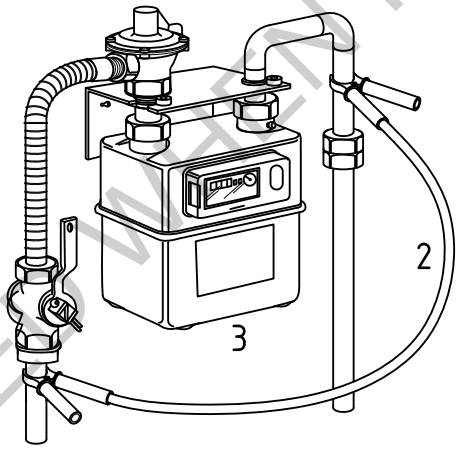
b) Clip or clamp a temporary continuity bond to each side of the union, fittings or complete section to be removed or connected, ensuring that good, secure, metallic contact is made (see Figure 7).

c) Leave the bond in position until after the work is completed and metallic continuity re-established. Where pipework is to be removed, ensure that both sections of pipework left are bonded before removing the temporary electrical continuity bonding conductors.

Figure 7 **Use of temporary continuity bond**



a) At pipe



b) At meter

Key

1 Pipework to be cut out
2 Temporary continuity bond
3 Meter to be temporarily removed

8.3.5 Before any work is commenced on an installation, or section of an installation, where there is a risk of any gas within the pipework being ignited and constituting a danger (for example, when using a blowlamp) the following precautions shall be taken.

a) Conduct a tightness test in accordance with IGEM/UP/1 [21], IGEM/UP/1A [22] or IGEM/UP/1B [23], as appropriate, on the installation or section of the installation, in particular to verify that there is no let-by from the valve used to isolate the gas supply. Where a leak or let-by is found, rectify this before proceeding.

b) Disconnect the gas supply to the installation or section of the installation.

c) Remove any meter, where fitted in the section to be worked upon, from the installation or section of the installation.

d) Immediately seal all exposed gas ways, for example open ends on the pipework and/or meter, with an appropriate fitting.

e) Increase natural ventilation in the work area where possible.

Oxy-gas flame cutting equipment shall not be applied to any pipework or fitting containing gas. When working with a naked flame or other source of heat in the vicinity of combustible material, precautions shall be taken to avoid a fire hazard.

*COMMENTARY ON **8.3.5***

These are safety precautions that might reduce the risk of any gas being inadvertently ignited and constituting a danger. Where it is considered that, even when having taken these measures there could still be a risk of gas igniting, the gas operative may choose to purge the installation of any gas. Additional guidance on purging installations of any gas (decommissioning) can be found in IGEM/UP/1 [21], IGEM/UP/1A [22] and IGEM/UP/1B [23].

It is difficult to specify an exact set of parameters that indicate when an installation will or will not need to be decommissioned prior to working on it due to the diversity of installations that might be encountered.

8.3.6 All open ends of the pipework shall be sealed with an appropriate fitting before any work is left unattended.

8.3.7 Where work is in progress on the pipework that exposes the gas ways, for example open ends on the pipework, sources of ignition shall be kept away from the exposed gas ways.

8.3.8 When work has been completed, the open ends of pipework shall be sealed with an appropriate fitting that will facilitate purging the installation, for example suitably plugged or capped.

8.3.9 When any installation is to be decommissioned (for example, prior to the installation removal or property demolition), a risk assessment shall be carried out to determine whether there is a requirement to purge any fuel gas from the installation (see IGEM/UP/1 [21], IGEM/UP/1A [22] and IGEM/UP/1B [23]).

NOTE It is difficult to specify an exact set of parameters that state when an installation should or should not be purged of fuel gas (decommissioned) due to the diversity of installations that can be encountered.

Where the meter is removed BS 6400 should be consulted.

8.3.10 Where any pipework is no longer required, the pipework shall be disconnected as close to the point of connection to the live gas supply as practicable. In all circumstances, any exposed gas ways shall be sealed with an appropriate fitting and any part of the installation that might contain gas shall be labelled as such.

8.3.11 Precautions shall be taken to avoid damage to any electrical conductor when installing pipework.

8.4 Interrelation with other services

8.4.1 General

8.4.1.1 Pipework shall be located or electrically insulated such that it does not touch metallic fitments that could promote electrolytic corrosion.

8.4.1.2 Pipework shall:

a) not be installed in a ventilation or air-conditioning duct (see **8.1.11** and **8.1.12** for pipework in the fireplace opening); and

b) be physically spaced from other services, such as water, electricity, telecommunications and drainage.

8.4.1.3 Pipework shall not be buried in floors together with electrical underfloor heating, unless the underfloor heating has been physically and permanently disconnected.

8.4.2 Separation of pipework from electrical services

8.4.2.1 Where installation pipework is not separated from electrical equipment or cables by an insulating enclosure, dividing barrier, trunking or conduit, it shall be spaced as follows:

a) at least 150 mm away from electricity supply equipment, such as metering equipment, main service cut-outs or supplier (main) isolation switches, and distribution boards or consumer units; or

b) at least 25 mm away from electrical switches, sockets and electricity supply and distribution cables.

8.4.2.2 The installation pipework shall not be positioned in a manner that prevents the operation of any electrical accessory, i.e. a switch or socket outlet.

NOTE Where these spacing requirements are impracticable the pipework should either be sheathed with an electrical insulating material rated at 230 V ac or more, or a panel of electrical insulating material should be interposed.

8.4.3 Main protective bonding conductor

8.4.3.1 A gas installation within a property with an electrical supply shall have a main protective bonding conductor connecting the pipework to the electrical installation's main earth terminal, as specified in BS 7671.

*COMMENTARY ON **8.4.3.1***

The purpose of protective bonding is to create a zone in which voltage differences through differing earth potentials are eliminated, and therefore hazards from electric shocks are minimized. This is achieved by connecting separate conductive components, such as the various metallic building services and structural steelwork, together with a main protective bonding conductor at the main earth terminal.

It is possible for stray currents to be transmitted through the gas pipework. 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.

8.4.3.2 The main protective bonding conductor (main equipotential bonding connection) shall be connected to the gas consumer's fixed rigid pipework on the outlet of any primary meter installation, if fitted:

a) as near as is practicable to the point of entry into the premises;

b) before any branch in the pipework;

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

d) by a mechanically and electrically sound connection which is not subject to corrosion.

The main protective bonding conductor (main equipotential bonding connection) shall not be directly connected to any pliable corrugated (stainless-steel) tube or pliable connectors from the outlet of the primary meter installation.

*COMMENTARY ON **8.4.3.2***

The main protective bonding conductor on the gas pipework should be made using cable with minimum cross-sectional area of 10 mm^2 cable with green and yellow insulation, construction reference 6491X conforming to BS 6004.

For internal meters, for verification purposes the bonding connection should be within 600 mm of the meter outlet union.

For meters in outside meter boxes/compartments, the bonding connection should preferably be inside the premises and within 600 mm of the point of entry of the pipework into the premises.

Alternatively, the connection can be made within the box/compartment, but it is essential that the bonding cable does not interfere with the integrity of the box/compartment and the sealing of any sleeve (see Figure 8).

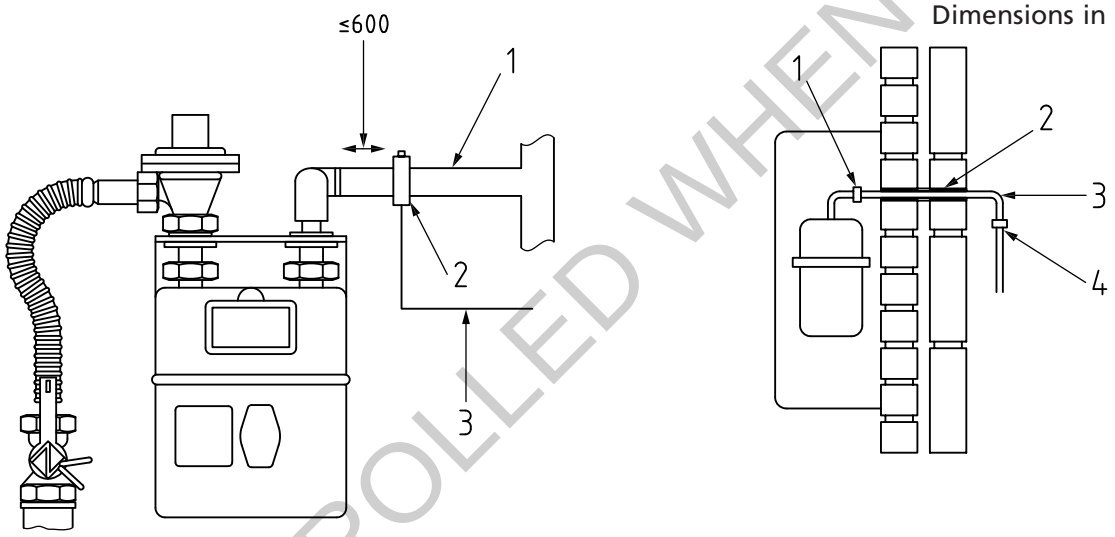
For guidance on equipotential bonding in multi-dwelling buildings see IGEM/GM/5 [26].

*When relocating a meter, an existing main protective bond conductor might be satisfactory as found, or it might need to be altered. Where the bonding conductor requires altering, any alterations should be carried out by an electrically competent person, and inspected and tested in accordance with BS 7671. The bonding connection may be considered satisfactory if the requirements of **8.4.3.1** are met.*

Further guidance on the connection to installations containing pliable corrugated (stainless-steel) tube can be obtained from the product manufacturer.

Figure 8 **Position of main protective bonding conductor connection**

Dimensions in millimetres



a) Internal meter installation

Key

1 Pipework
2 Bonding connection
3 Green-yellow cable to consumer earth terminal

b) Meter installation in external box/ compartment

Key

1 Bonding connection (non-preferred position)
2 Pipework sleeve (sealed)
3 Pipework
4 Bonding connection (preferred position)

NOTE For medium-pressure fed meter installations the main protective bonding conductor should only exit the box as detailed in BS 6400-2 and BS 6400-3.

8.4.3.3 When new pipework is installed, the installer of the pipework shall, where they are competent to do so, carry out the installation of any necessary bonding at the time of the installation.

*COMMENTARY ON **8.4.3.3***

Regulation 18(2) of the Gas Safety (Installation and Use) Regulations 1998 [1] requires that any person who connects any installation pipework to a primary meter, in any case where equipotential bonding might be necessary, has to inform the responsible person for the premises that such bonding should be carried out by a competent person.

A typical form of notification is a letter or card, an example of which is given in Figure 9.

On existing installations where a main protective bonding conductor might be necessary, the operative should pass such notification to the responsible person.

Figure 9 **Typical notification where main protective bonding conductor is found not to be present**

MAIN PROTECTIVE BONDING CONDUCTOR

Most electrical installations are required to be fitted with a main protective bonding conductor, which consists of the electrical connection of the internal gas and water pipes to the installation's main earthing terminal in accordance with the requirements of BS 7671, *Requirements for electrical installations* (IET Wiring Regulations).

The gas installation pipework fitted in your premises does not appear to have the necessary main protective bonding conductor.

I am required by The Gas Safety (Installation and Use) Regulations 1998 to tell you that any necessary main protective equipotential bonding should be carried out by a competent person.

I advise you to have this checked by a competent electrical operative.

If you are the tenant of this property, please bring this matter to the attention of the owner or their agent as soon as possible.

8.4.4 Electro-osmotic damp-proofing

Where electro-osmotic damp-proofing has been installed in a property, all metallic gas pipework shall be located above ground floor level.

*COMMENTARY ON **8.4.4***

This type of damp-proofing system is designed to be installed in older properties built without a proprietary damp-proofing membrane. It consists of a titanium wire running around the base of the walls, with platinized electrodes embedded in the walls at intervals and a copper earth rod buried near the centre of the building. A small positive voltage applied to the titanium wire is claimed to interfere with the natural potential in the walls, thereby altering the mechanics of water flow.

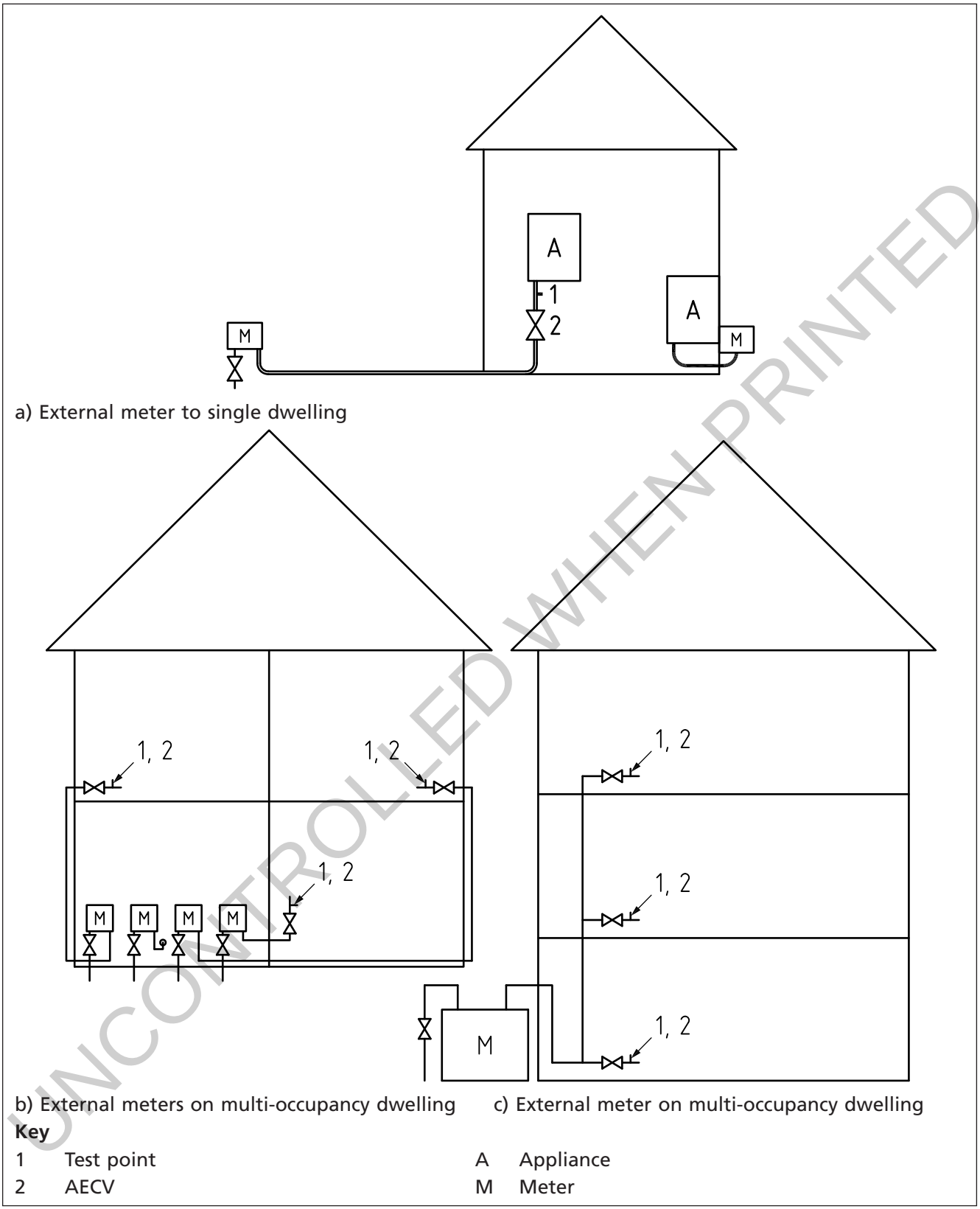
Perforation of metallic pipework can occur whenever it is in contact with the fabric of the building below the level of the titanium wire, i.e. where a conductive path was provided between the two materials by the moisture in the wall. The copper pipework might corrode preferentially because titanium is the more "noble" (resists chemical action) material and because the induced voltage increases the potential differences and could produce very rapid corrosion.

8.5 Valves

8.5.1 Additional emergency control valves (AECV)

8.5.1.1 An additional emergency control valve (AECV) shall be fitted where the emergency control valve (ECV) is located remotely from the dwelling/building it serves (see Figure 10).

Figure 10 **AECV positions** *(1 of 2)*



a) External meter to single dwelling

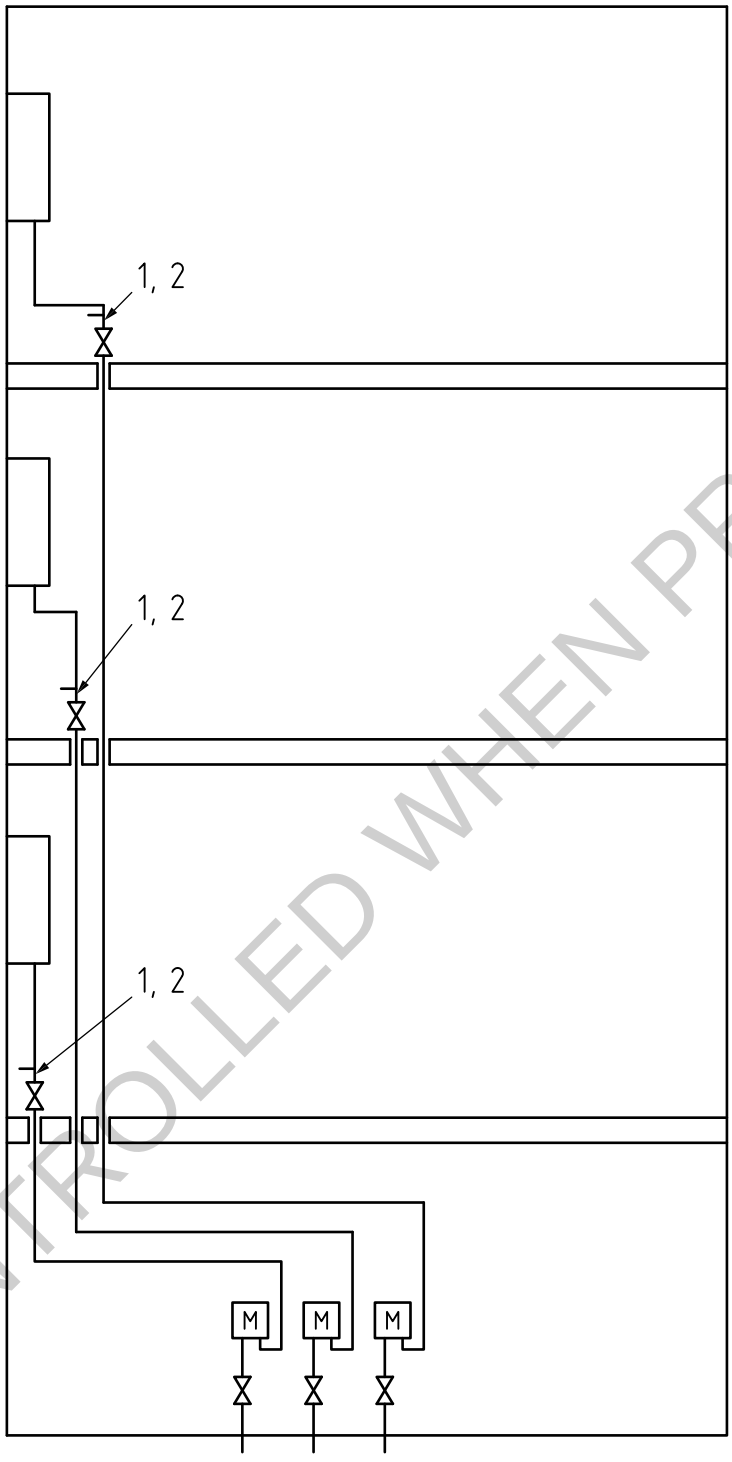
b) External meters on multi-occupancy dwelling

c) External meter on multi-occupancy dwelling

Key

1 Test point
2 AECV
A Appliance
M Meter

Figure 10 **AECV positions** *(2 of 2)*



d) Internal meters on multi-occupancy dwelling

Key

1 Test point
2 AECV
M Meter

8.5.1.2 Every AECV shall:

a) be located as near as practicable to the point of entry of the installation pipework into the dwelling/building;

b) be labelled or marked to show its open and closed position;

c) be fitted in a readily accessible position;

NOTE An appropriate height for an AECV is between 450 mm and 1 450 mm above floor height.

d) be easy to operate;

e) be securely fitted with a suitable handle or other permanent means of operation; and

f) where the lever moves in the vertical plane, move to the "off" position in a downward direction.

8.5.1.3 A permanent notice shall be attached to the valve giving the following information:

a) advice that the valve is an "emergency control for gas consumers' use";

b) details of the parts of the installation isolated by the valve;

c) the telephone number of the National Gas Emergency Call Service or the LPG supplier Emergency Service, as appropriate; and

d) advice to the gas consumer on actions to be taken if they think they can smell gas.

8.5.2 External pipework isolation valves

Where the pipework is taken from inside a building to supply an appliance situated externally (see Figure 11), a valve shall be installed in an accessible position where the pipework leaves the building.

NOTE It is preferable that the valve be fitted externally. Appliances such as patio heaters and barbecues are fitted externally.

8.6 Pressure test points

8.6.1 A pressure test point shall be fitted for the purpose of gas tightness testing. Where there is no meter installed that includes a test point, a test point shall be fitted not more than 300 mm downstream of the ECV or any AECV.

NOTE Careful consideration should be given to the positioning of the test point to allow for ease of tightness testing.

8.6.2 Where a suitable test point is not provided with the appliance, a test point shall be fitted at the point to be connected on any fixed appliance inlet.

NOTE This test point can be incorporated into the appliance isolation valve.

8.7 Sleeves

8.7.1 Pipework passing through a wall or a floor, whether or not it contains a cavity, shall pass through a sleeve.

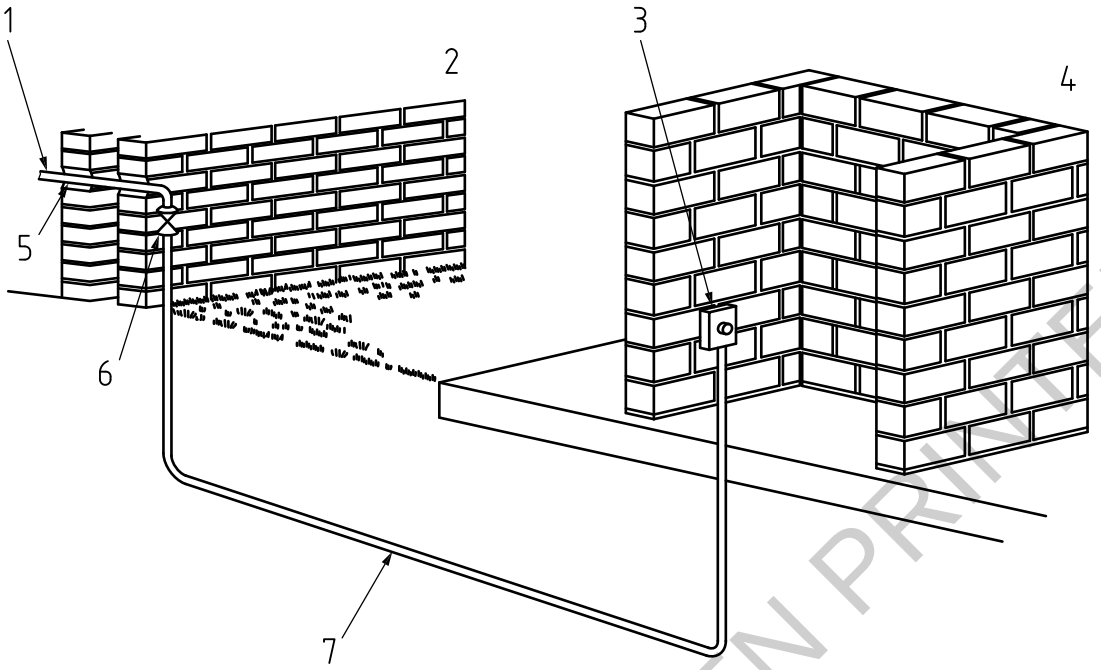
8.7.2 All sleeves shall be of a material:

a) resistant to corrosion;

b) impermeable to gas, e.g. copper, steel, PE or polyvinyl chloride (PVC); and

c) capable of protecting the pipework against failure caused by movement of the structure.

Figure 11 **Typical exterior pipework**



Key

1	Gas supply to external location	5	Pipe sleeve
2	House wall	6	External pipework isolation valve
3	Leisure point	7	Pipework
4	Barbecue		

8.7.3 No sleeve shall have joints along its length.

*COMMENTARY ON **8.7.1**, **8.7.2** AND **8.7.3***

*Factory-applied coatings or covers on pipe do not fulfill the purpose of a sleeve as defined in **3.38**.*

Consideration should be given to the selection of the material for a sleeve to ensure that it has no detrimental effect on the pipework installation, such as electrolytic corrosion caused by dissimilar metals.

8.7.4 Any sleeve shall pass through the full width of the wall or the full thickness of the floor. The outside of the sleeve shall be secured and sealed at each end to the structure of the building with a suitable building material, e.g. cement mortar or flexible sealant.

8.7.5 Any sleeve shall not impair the structural stability, fire resistance, or thermal and sound insulation of a building. The annular space between the pipework and the sleeve shall be sealed at one end to the pipework with a flexible fire-resistant compound. Where a sleeve passes through an exterior wall, the sealing of the annular space between the pipework and the sleeve shall be on the inside of the wall. However, for a sleeve that forms part of a low-pressure fed meter installation sited in a meter housing, the seal shall be inside the housing.

NOTE The internal diameter of any sleeve should allow for an annular space around the pipework to enable satisfactory insertion and withdrawal of the pipework and allow adequate sealing between the pipework and the sleeve.

8.7.6 Screwed, quick-release and mechanical joints and press end connections shall not be located on the pipework within a sleeve.

8.8 Pipework support

8.8.1 All pipework shall be adequately supported in accordance with specific manufacturers' instructions or, in the absence of such instructions, with Table 4.

8.8.2 All pipework supports shall be suitable for the environment in which they are installed and shall be designed to remain stable for the lifetime of the installation, e.g. for external use corrosion resistant or UV-stabilized plastic.

8.8.3 Where pipework is installed in protected areas (see **8.19** and Annex D), all supports shall be fire-resistant, e.g. of metallic construction.

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

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

Table 4 **Maximum interval between pipework supports**

Material	Nominal size	Interval for vertical run m	Interval for horizontal run m
Steel (rigid)	Up to DN 15 (R½)	2.5	2.0
	DN 20 (R¾)	3.0	2.5
	DN 25 (R1)	3.0	2.5
	DN 32 (R1¼)	3.3	2.7
Copper	Up to 15 mm	2.0	1.5
	22 mm	2.5	2.0
	28 mm	2.5	2.0
	35 mm	2.5	2.5
Pliable corrugated (stainless-steel)	DN 15	1.2	1.2
	DN 20/22	1.8	1.8
	DN 25/28	1.8	1.8
	DN 32	2.5	2.5

8.9 Pipework laid in joisted floors and roof spaces (including compartment floors)

8.9.1 Where pipework is to be installed in joisted floors and roof spaces it shall run either in the direction of the joists or at 90° to the joist direction. Diagonal runs of pipework shall not be installed.

8.9.2 Where pipework is installed parallel to or at 90° to joists in floors, intermediate floors or roof spaces, it shall be supported in accordance with Table 4.

8.9.3 The flanges of timber-engineered joists and metal web joists shall not be notched, drilled, altered or damaged (see Figure 12).

8.9.4 Where pipework is installed at 90° to timber-engineered joists with I-beam construction, the pipework shall be installed through the web of joists in accordance with the joist manufacturer's guidance (see Figure 12).

Where pipework is installed at 90° to laminated timber joists with a rectangular cross section, the pipework shall be installed in accordance with the joist manufacturer's guidance.

8.9.5 Where pipework is installed at 90° to metal web joists with timber flanges, the pipework shall pass between the metal webs with pipework supported on the wooden flanges and not in contact with the metal structure of the joist (see Figure 12).

Where pipework is installed at 90° to metal web joists with metal flanges, the pipework shall pass between the metal webs with pipework supported in such a manner that it is not in direct contact with the metal of the joist structure.

NOTE Additional guidance might be available from the joist manufacturer.

8.9.6 Where pipework is laid across solid timber joists fitted with flooring, the pipework shall be located in purpose-made notches or circular holes. Notches and holes shall conform to Figure 13.

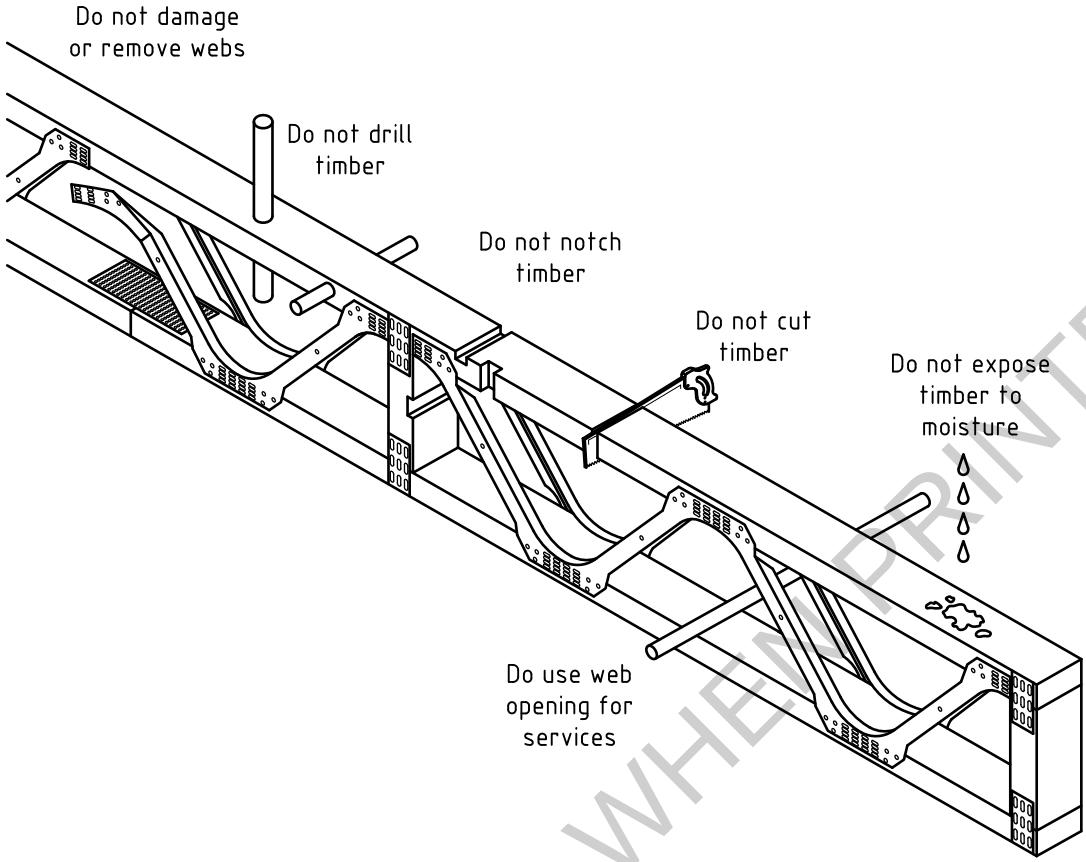
8.9.7 Solid timber joists with a depth less than 100 mm or greater than 250 mm shall not be notched, unless this has been confirmed as acceptable by a structural engineer.

8.9.8 Where pipework is installed within roof spaces, roof rafters, purlins, trussed rafters, bracing, etc., shall only be notched, drilled or cut away with the approval of a structural engineer.

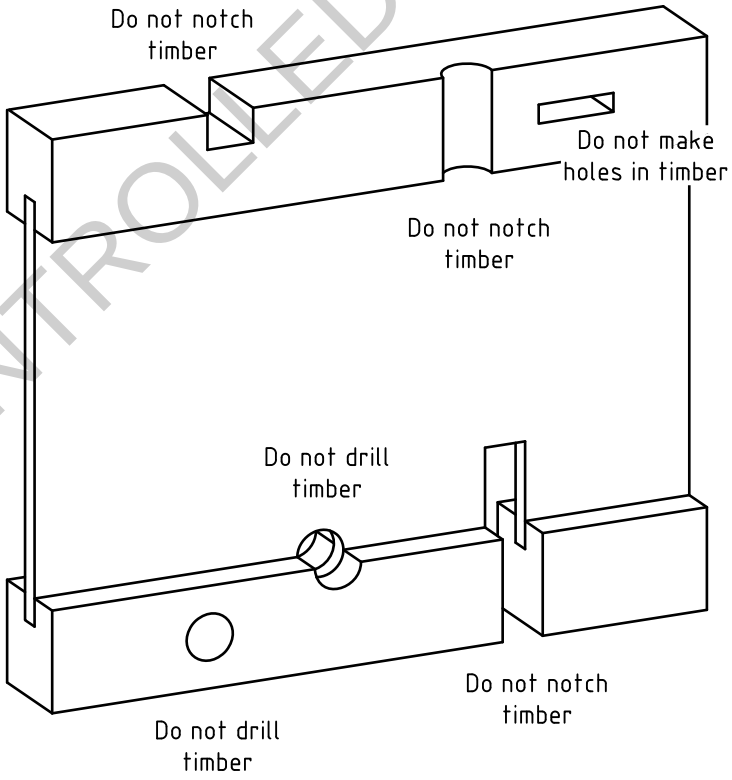
8.9.9 Where pipework is installed in a void under a floor, unless there is sufficient adventitious ventilation available, ventilation shall be provided in accordance with **8.16.1**, Table 6. For LPG and LPG/air mixtures this ventilation shall be at the lowest point. Alternatively, the gas pipework shall be contained within a vented duct where it passes through the void.

NOTE Additional guidance on LPG gas installations under the floor of a residential park home or dwelling manufactured to BS 3632 is given in HSE report RR945 [27].

Figure 12 **Notching and drilling of metal web joists and timber-engineered joists**



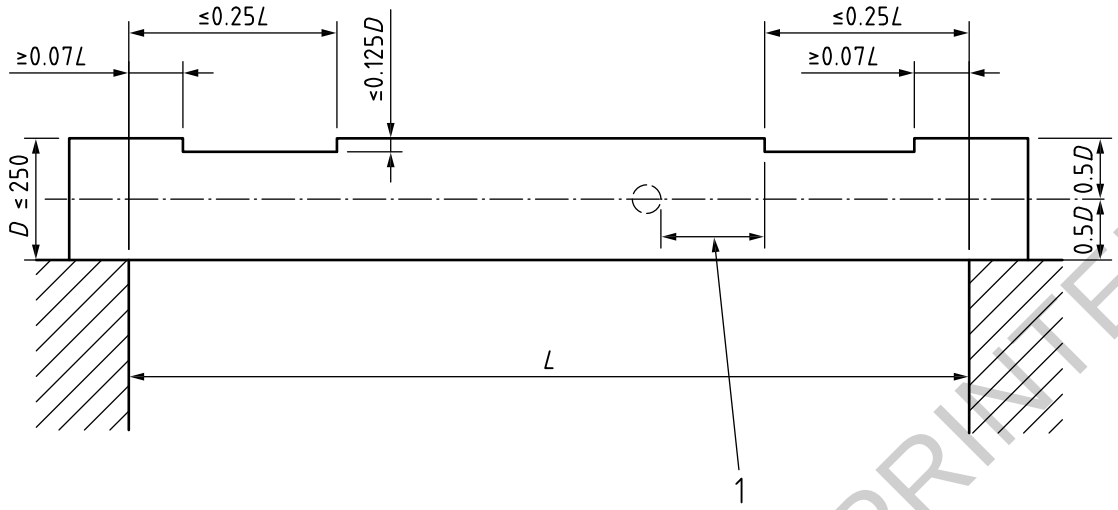
a) Restrictions on notching and drilling metal web joists



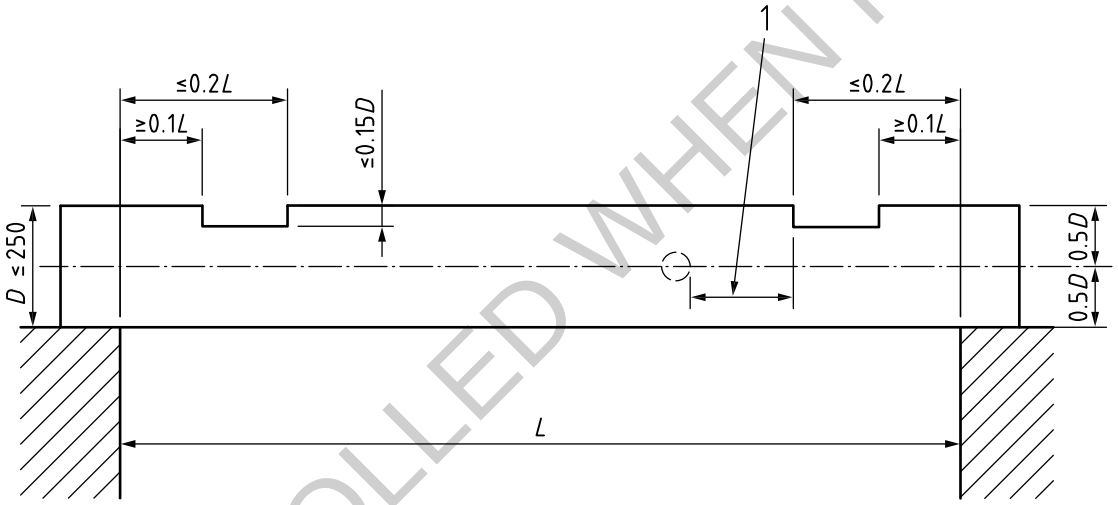
b) Restrictions on notching and drilling timber-engineered joists

Figure 13 **Limits for notching and drilling of solid timber floor joists** *(1 of 2)*

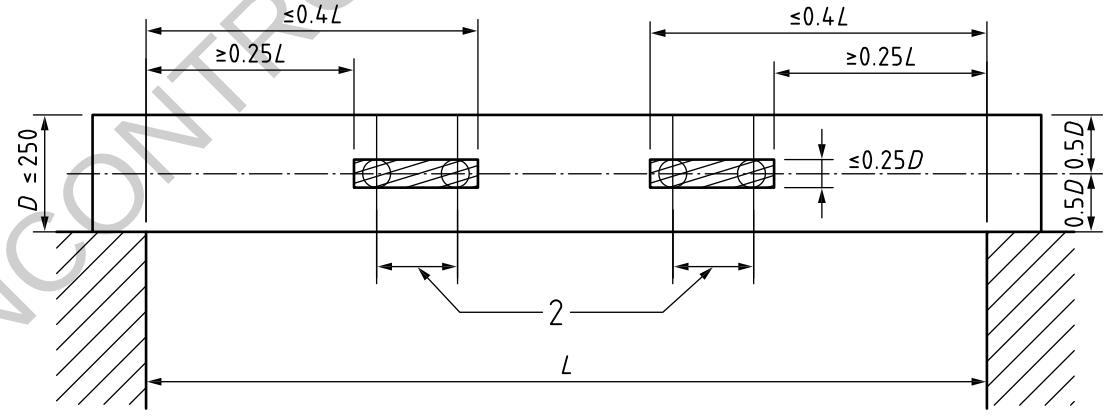
Dimensions in millimetres



a) Limits for notching top of joist where drilling and notching occur



b) Alternative limits for notching top of joist where drilling and notching occur



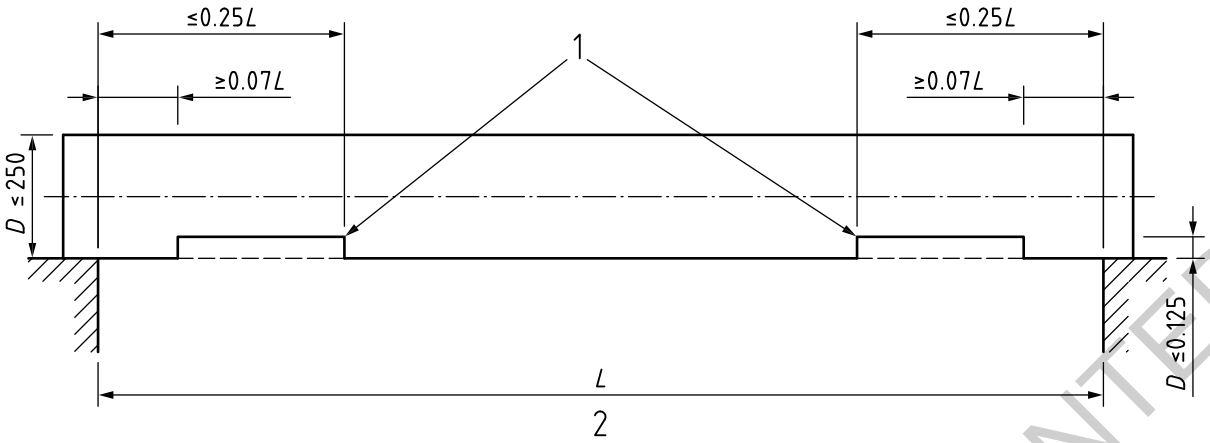
c) Limits for drilling of joists where drilling and notching occur

Key

1 Min. 100 mm between notch and hole 2 Holes not closer than 3 × diameter

NOTE 1 The notching can occur at both ends, either on top or bottom, without a design check.

Figure 13 **Limits for notching and drilling of solid timber floor joists** *(2 of 2)*



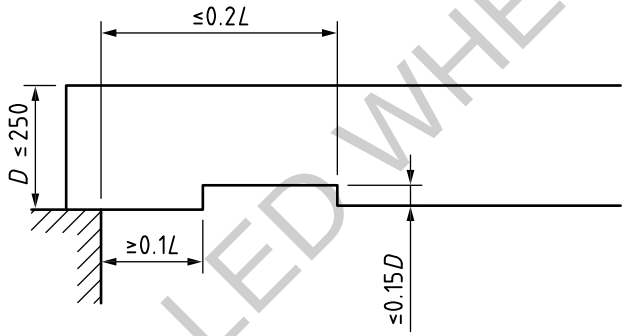
Key

1 Positions within which notching can occur on the bottom without a design check. Minimum 100 mm between the notch and any holes [see Figure 13a)].

2 Clear span simply supported joist (not a trimmer, trimming joist or beam)

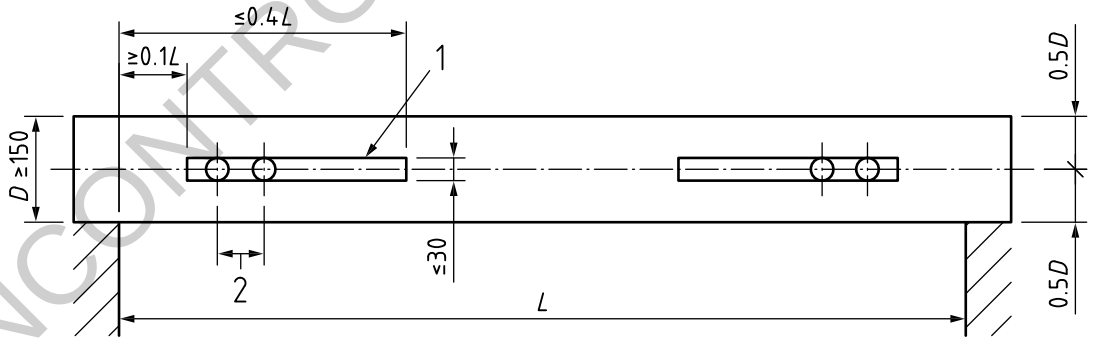
NOTE 2 The notching can occur at both ends, either on top or bottom, without a design check.

d) Limits for notching bottom of joist where drilling and notching occur



NOTE 3 The notching can occur at both ends on the bottom without a design check.

e) Alternative limits for notching: bottom of joist where drilling and notching occur



f) Alternative drilling zone where no notching occurs

Key

1 Drilling zone where no notching occurs

2 Holes not closer than 3 × diameter of largest hole and a maximum of 8 × 30 mm holes can be accommodated within each drilling zone. No notching is permitted.

8.9.10 Where pipework is installed within intermediate joisted floors, unless there is sufficient adventitious ventilation available, ventilation shall be provided in accordance with **8.16.1**, Table 6. For LPG and LPG/air mixtures this ventilation shall be at the lowest point.

*COMMENTARY ON **8.9.10***

General

Prior to running pipework below 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.

Where it is necessary during installation or retrofitting to remove a section of floor boarding or decking, the section should be reinstated to the same standard as that before removal. Any cut edge of a floor decking should be supported by noggings fixed between the joists.

Care should be taken when fixing flooring or ceilings to prevent damage to the pipework by nails or screws. Where possible, the flooring should be appropriately marked to warn others. Where possible, the design should remove the need for notching solid timber joists.

Natural gas

For natural gas, research undertaken by Advantica [28] (see Annex C) on behalf of the Gas Industry Safety Group (GISG) has proved that, where gas pipework is installed in intermediate floors in dwellings, there is sufficient adventitious ventilation of the floor construction to safely disperse any minor leakage of gas, i.e. natural ventilation via cracks/openings in the structure is sufficient to ensure any minor escapes of gas do not present a danger.

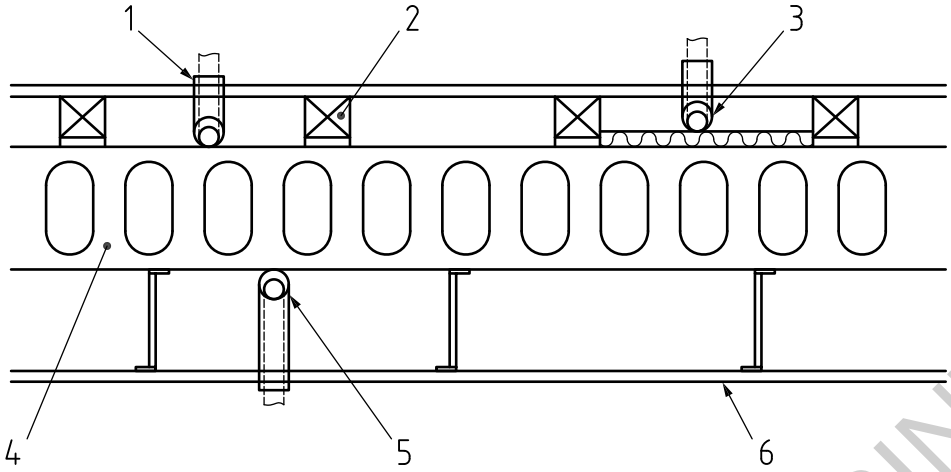
Therefore, there is no requirement to install purpose-provided ventilation to floors of this construction in conventional masonry, timber frame or light steel frame buildings. A summary of the research project and its principal conclusions can be found in Annex C. The results and conclusions of this report should not be applied to compartment floors between dwellings, for example in the floors which separate one flat or apartment from another. The results and conclusions of this report apply to natural gas installations only and should not, therefore, be applied to installations supplied with LPG or LPG/air gas mixtures.

8.9.11 Pipework shall not be installed within any fire compartment floor that separates one dwelling from another part of the building, except as shown in Figure 14 and Figure 15.

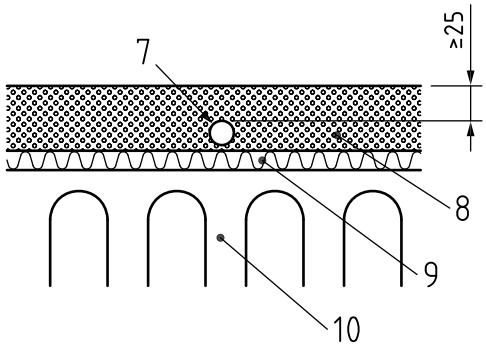
8.9.12 Roof spaces utilizing vapour permeable underlay without specific ventilation, such as soffit board vents, shall be treated as unventilated voids for the purpose of gas pipework and appliance installations. Where it is necessary to install pipework in such locations, additional ventilation shall be applied having at least two ventilators per space, each with a free area of at least 50 cm^2. For LPG and LPG/Air mixtures, this shall be at low level; for natural gas this shall be at high level.

8.9.13 Pipework shall not be laid below or within roof space insulation material.

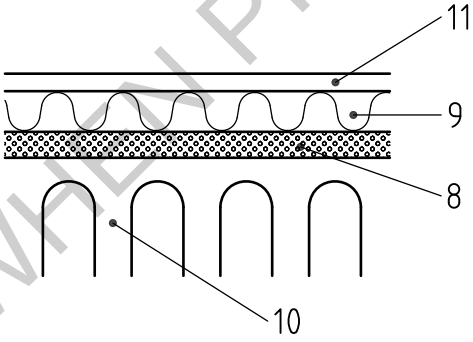
Figure 14 **Pipework in concrete compartment floors**



a) Typical concrete compartment floor with suspended ceiling and topping of timber decking on battens



b) Alternative screed topping



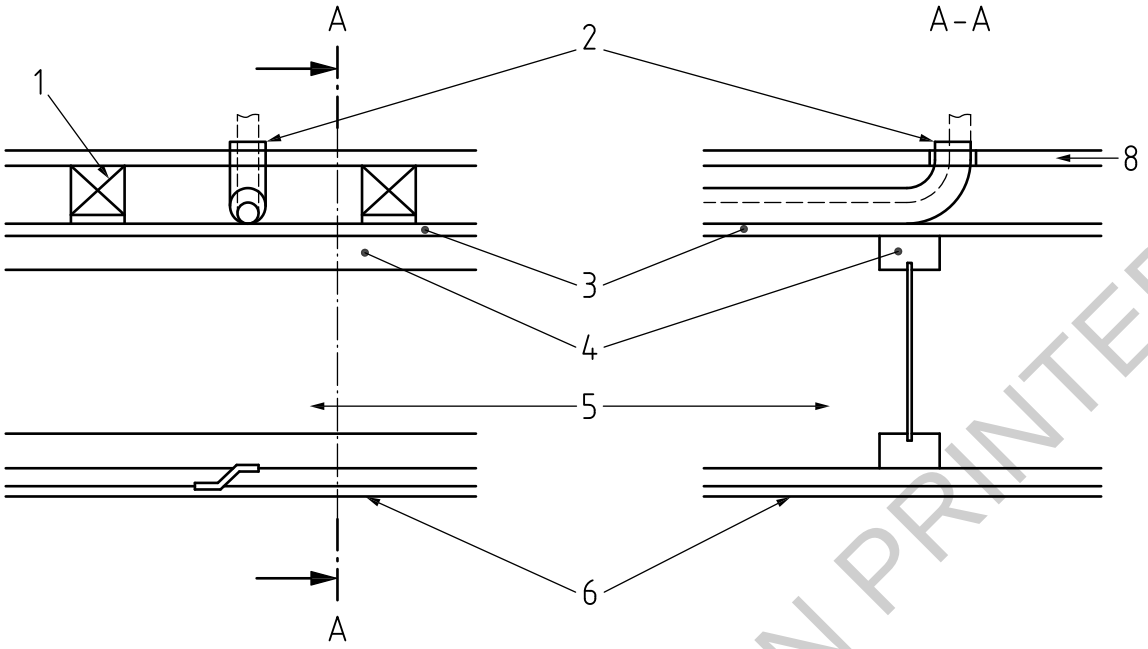
c) Alternative timber floating floor topping (No pipework to be installed in this type of floor topping)

Key

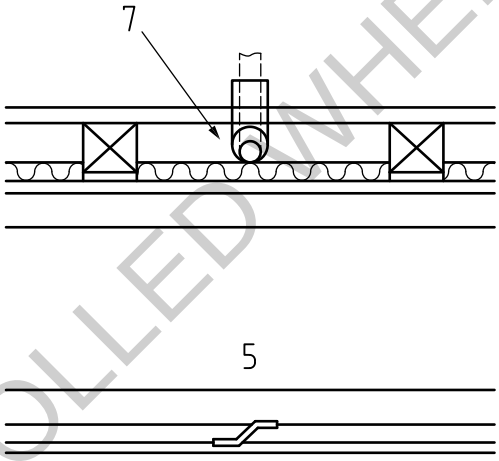
1 Pipework within vented ducting extended above floor level and sealed to floor deck with flexible sealant
2 Floor decking on battens on resilient bearers/pads
3 Ducted pipework can be above or below any resilient quilt laid between floor battens with no fixings used to secure the ducting penetrating or damaging the quilt
4 Structural floor slab
5 Pipework within vented ducting located within suspended ceiling void and sealed to ceiling board
6 Suspended ceiling
7 Pipework with factory-finished protection laid in screed above resilient overlay [A)]
8 Screed
9 Resilient sound-proofing overlay
10 Structural floor slab
11 Floating floor

[A)] Exposed metallic pipework, for example at joints, shall be further protected on site (see **8.1.7** to **8.1.12**).

Figure 15 **Pipework in timber fire compartment floors**



a) Typical suspended timber compartment floor



b) Typical suspended timber compartment floor incorporating resilient quilt

Key

1 Floor decking on battens on resilient bearers/pads
2 Pipework within vented ducting extended above floor level and sealed to floor deck with flexible sealant
3 Structural deck
4 Timber joist
5 No pipework in this void
6 Ceiling fixed to resilient bars
7 Ducted pipework can be above or below any resilient quilt laid between floor battens with no fixings used to secure the ducting penetrating or damaging the quilt
8 Floor deck

8.10 Pipework installed in solid floors

8.10.1 Where pipework is to be installed in solid floors it shall run parallel or at 90° to the walls.

8.10.2 Pipework shall not be buried in structural elements of the floor, such as concrete slabs or structural toppings. Pipework shall not be buried in power-floated floors that form part of the structure.

8.10.3 Pipework in acoustic floors shall only be installed with the agreement of the building designer.

8.10.4 Rigid stainless-steel pipework shall not be buried in floor screeds.

8.10.5 Pipework that is to be buried in a solid floor shall be suitably protected against corrosion and degradation (see **8.1.7** to **8.1.12**). Galvanized or painted pipework shall not be buried without additional onsite protection being applied (see **8.1.7** to **8.1.12**).

8.10.6 Pipework installed in solid floors shall be protected against failure caused by movement.

*COMMENTARY ON **8.10.6***

Pipework installed in solid floors should, where practical, be in one length without any joints. Where necessary, the use of fittings should be kept to a minimum and, where aesthetically and practicably acceptable, bends should be used in preference to elbows.

Suitable methods of protection are as follows:

*a) pipework laid on top of concrete slabs/precast flooring and subsequently covered by a floor screed (see also **8.1.7** to **8.1.12**);*

b) steel or copper pipework installed into preformed ducts with protective covers; and

c) steel or copper pipework fitted with additional soft, non-permeable covering material. The coverings should be soft and thick enough to provide movement, yet resilient enough to support the floor screed 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 **8.1.7** to **8.1.12** for the application of adequate corrosion protection.*

8.10.7 Where pliable corrugated (stainless-steel) tube is to be buried in floor screed, it shall be:

a) directly buried pliable corrugated (stainless-steel) tube which:

   1) conforms to **6.2.3;**

   2) the manufacturer's instructions specifically allow direct burial;

   3) is installed in accordance with the manufacturer's instructions; and

   4) has a factory-applied cover with a minimum thickness of 0.5 mm, manufactured from a non-chlorinated material of a synthetic polymer or elastomer with a total chloride content not exceeding 50 ppm; or

b) laid inside a buried outer pipe conforming to **8.7.1** or a covered channel which terminates either above floor level or with suitable inspection points which permit periodic inspection.

NOTE Users of this British Standard are advised to consider the desirability of selecting products for which independent quality assurance certification against the appropriate product manufacture standard has been obtained.

8.10.8 Where pipework is to be buried in magnesium-oxy-chloride cement or magnesite flooring, it shall be:

a) directly buried pre-insulated copper tube with solid covering conforming to BS EN 13349; or

b) directly buried pliable corrugated (stainless-steel) tube which:

   1) conforms to **6.2.3**;

   2) the manufacturer's instructions specifically allow direct burial;

   3) is installed in accordance with the manufacturer's instructions; and

   4) has a factory-applied cover with a minimum thickness of 0.5 mm, manufactured from a non-chlorinated material of a synthetic polymer or elastomer with a total chloride content not exceeding 50 ppm; or

c) laid inside a buried outer pipe conforming to **8.7.1** or a covered channel which terminates either above floor level or with suitable inspection points which permit periodic inspection.

NOTE Users of this British Standard are advised to consider the desirability of selecting products for which independent quality assurance certification against the appropriate product manufacture standard has been obtained.

8.10.9 All buried pipework shall be inspected for damage immediately prior to the tube being buried in the flooring material. Any damage shall be repaired in accordance with the manufacturer's instructions to give at least the same level of protection that was afforded before the damage.

NOTE The inspection should take account of any factory-finished protection or protection applied on site.

8.10.10 Where pipework is installed in solid floors, joints shall be kept to a minimum. Mechanical fittings and press end connections shall not be buried in solid floors, floor screeds or a concrete slab.

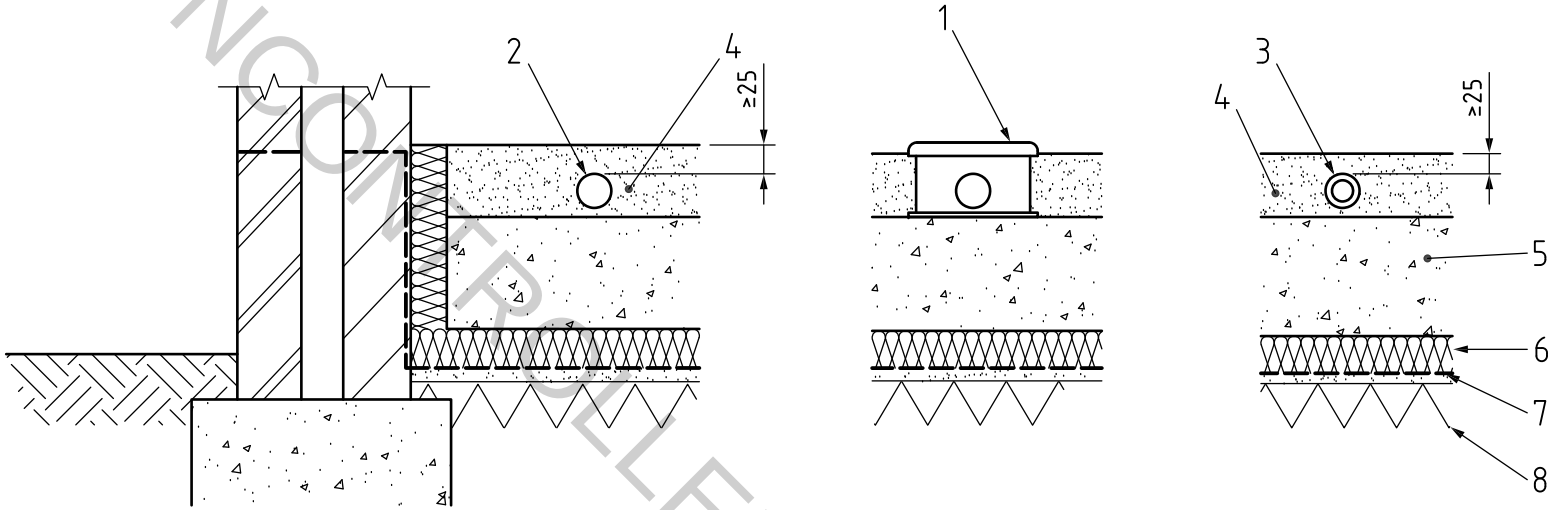
8.10.11 Pipework passing vertically through solid floors shall take the shortest practicable route and shall be sleeved (see **8.7**).

8.10.12 Where pipework is buried in a floor screed there shall be a minimum of 25 mm of cover above the pipework.

8.10.13 Pipework in solid floors shall be installed in accordance with Figure 16.

Figure 16 **Typical examples of pipework installed in solid floors** *&/ md 1'*

Dimensions in millimetres



a) Ground bearing concrete floors

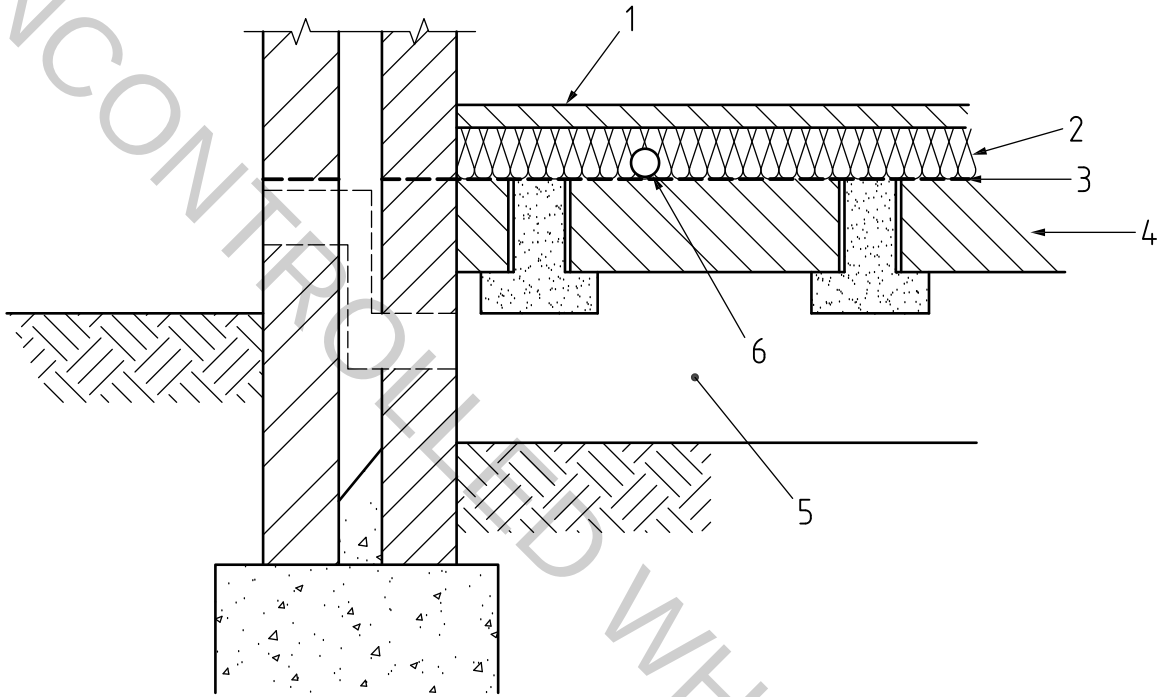
Key

1	Pipework laid in preformed duct	5	Concrete slab
2	Pipework with factory-finished protection laid in screed [A)]	6	Insulation
3	Pipework fitted with soft sleeving and laid in screed	7	Damp-proof membrane
4	Screed	8	Hardcore and sand blinding

[A)] Exposed metallic pipework, for example at joints, shall be further protected on site (see **8.1.7** to **8.1.12**).

Figure 16 **Typical examples of pipework installed in solid floors** *(2 of 3)*

Dimensions in millimetres



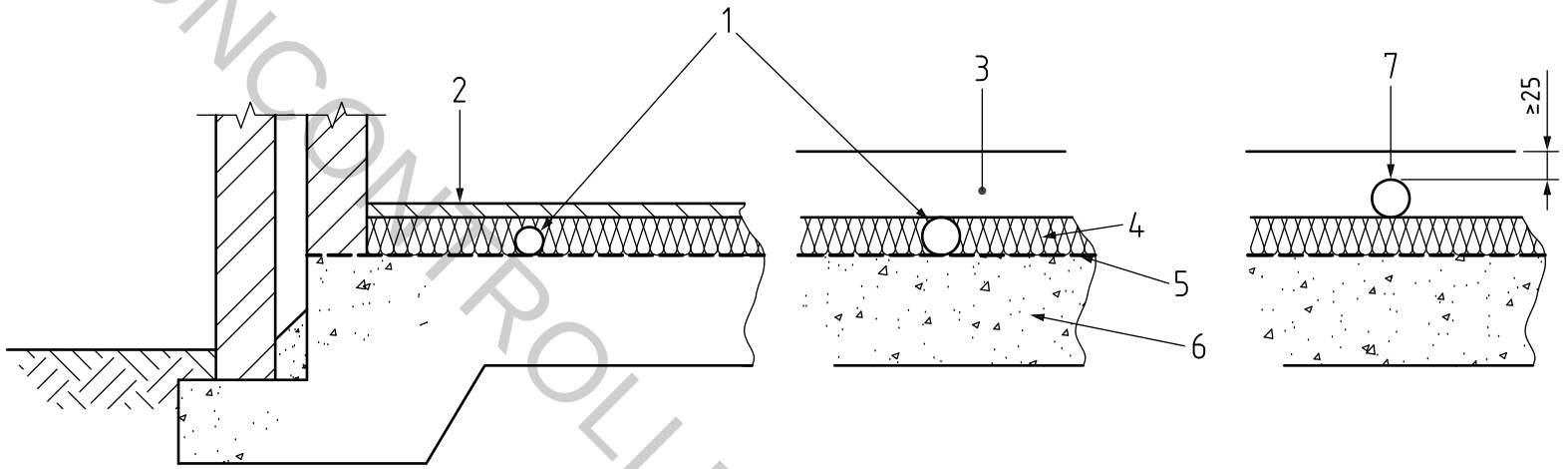
b) Suspended concrete floor

Key

1	Chipboard or floor screed over insulation	4	Precast beam and block
2	Insulation	5	Ventilated void
3	Damp-proof membrane	6	Pipework (corrosion protected as necessary)

Figure 16 **Typical examples of pipework installed in solid floors** *(3 of 3)*

Dimensions in millimetres



c) Concrete rafts

Key

1 Pipework laid in insulation layer (corrosion-protected as necessary)
2 Chipboard over insulation
3 Screed over insulation
4 Insulation
5 Damp-proof membrane
6 Concrete raft
7 Pipework with factory-finished protection laid in screed [A)]

[A)] Exposed metallic pipework, for example at joints, shall be further protected on site (see **8.1.7** to **8.1.12**).

8.11 Pipework installed in walls

8.11.1 General

8.11.1.1 Where pipework is to be installed into the building fabric of a wall it shall, where possible, be vertical and shall be placed in ducts with convenient access points or placed in pipework chases.

8.11.1.2 Any pipework installed within the building fabric of a wall shall take the shortest practicable route, horizontally or vertically. Diagonal runs of pipework shall not be installed.

8.11.1.3 Pipework in acoustic walls shall only be installed with the agreement of the building designer.

8.11.1.4 Pipework that is to be buried in walls shall be suitably protected against corrosion and degradation (see **8.1.7** to **8.12**). Galvanized or painted pipework shall not be buried without additional onsite protection being applied (see **8.1.7** to **8.12**).

8.11.1.5 Pipework installed in walls shall be protected against failure caused by movement.

8.11.1.6 All pipework shall be inspected for damage immediately prior to the tube being encased in building material. Any damage shall be repaired in accordance with the manufacturer's instructions to give at least the same level of protection that was afforded before the damage.

NOTE The inspection should take account of any factory finished protection or protection applied on site.

8.11.1.7 Where pipework is installed in walls, joints shall be kept to a minimum. Mechanical fittings and press end connections shall not be installed in walls.

8.11.1.8 The pipework shall be secured.

NOTE Typical methods of installing pipework in walls are shown in Figure 17.

Where pipework is permitted to be installed in acoustic walls it might need to be installed in special ducts to ensure no loss of acoustic performance.

8.11.2 Cavity walls

Pipework shall not be placed within the cavities of cavity walls. Pipework passing through a cavity wall shall take the shortest practicable route from one side to the other and shall be sleeved (see **8.7**).

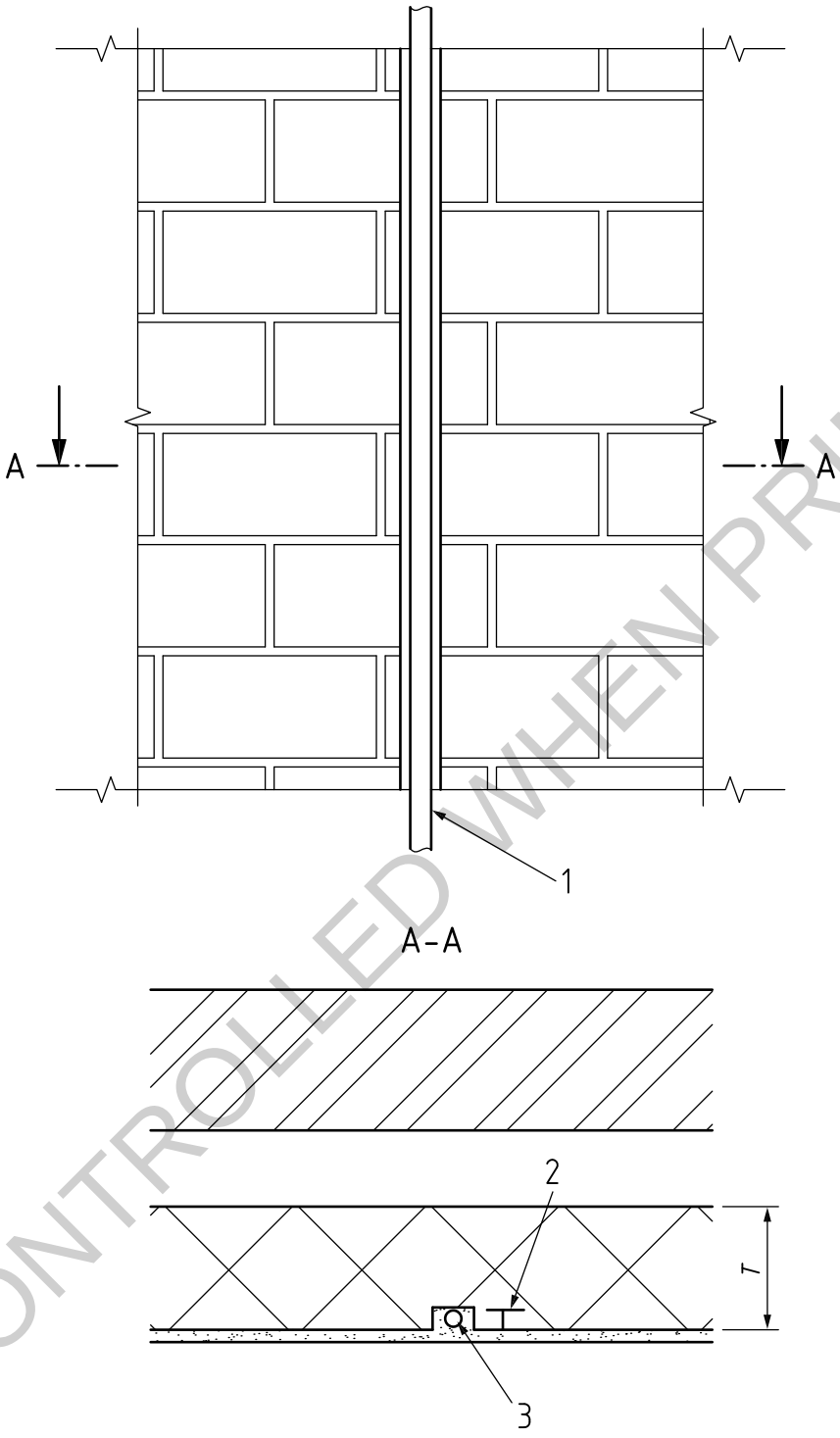
8.11.3 Dry lined solid construction walls

8.11.3.1 Pipework installed behind dry lining shall be suitably encased by building material to avoid gas tracking behind the plaster board.

8.11.3.2 Where thin wall metal pipework, for example copper and pliable corrugated (stainless-steel) tubing, is run between battens and within 50 mm of the decorative face of the plasterboard, it shall be protected suitably against penetration, for example with a steel plate of thickness 1 mm.

NOTE Suitable methods include continuous adhesive dabs or timber studs, as shown in Figure 17b) and Figure 17c).

Figure 17 **Typical examples of pipework installed in solid construction walls** *(1 of 3)*



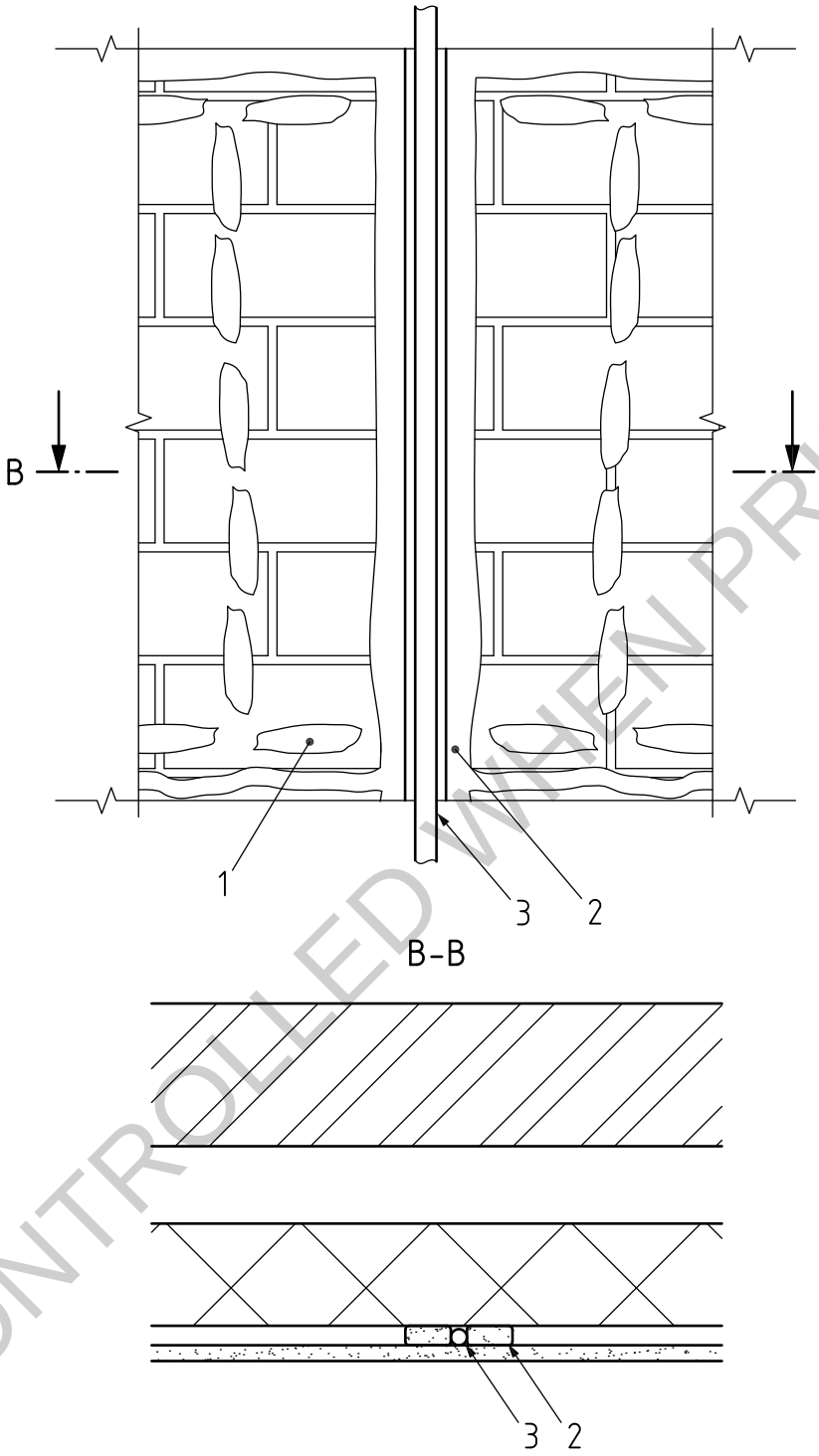
a) Brick and block plastered

Key

1 Pipework set in chase
2 Depth of chase
3 Pipework set into chase in plastered wall

Maximum depth of chase: *T*/6 horizontal; *T*/3 vertical

Figure 17 **Typical examples of pipework installed in solid construction walls** *(2 of 3)*

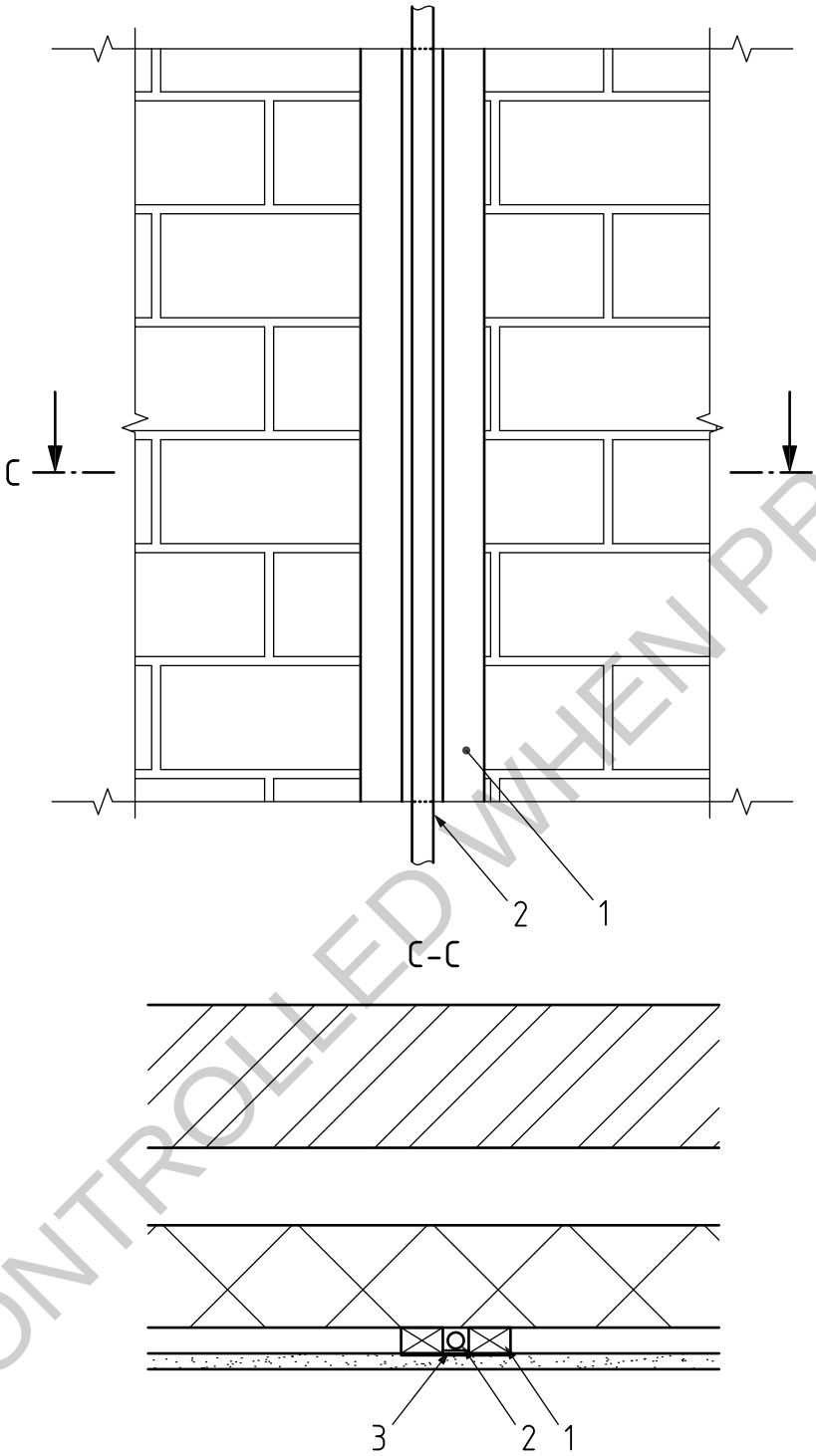


b) Brick and block with dry lining on dabs

Key

1 Individual adhesive dabs
2 Continuous adhesive dabs to surround pipework
3 Pipework

Figure 17 **Typical examples of pipework installed in solid construction walls** *(3 of 3)*



NOTE The joints between the wall and studs should be sealed with mastic in order to avoid gas tracking around the studs.

c) Brick and block dry lined on battens

Key

1 Timber battens
2 Pipework
3 Steel plate of min. 1 mm thickness

8.11.4 Timber-frame and light steel-framed walls

8.11.4.1 Pipework installed within the walls of timber-frame and light steel-framed construction shall be run within purpose-designed channels [see Figure 18a)] or ducts.

8.11.4.2 Pipework shall be installed such that any fixing cannot penetrate the pipework, for example plasterboard fixings, screws or shot-fired nails which are typically up to 50 mm long. This can be achieved by ensuring that the pipework is installed more than 50 mm from the front face of the plasterboard.

If this cannot be achieved, where thin wall metal pipework, for example copper and pliable corrugated (stainless-steel) tubing, is run within 50 mm of the decorative face of the plasterboard, it shall be protected suitably against penetration, for example with a steel plate of minimum thickness 1 mm (see Figure 18).

8.11.4.3 If it is necessary to drill or notch the bottom plate of the wall frame and/or the sole plate, as little timber as possible shall be removed, and not more than one third of the width of the bottom plate or sole plate shall be removed.

8.11.4.4 Where pipework is installed within timber and light steel construction walls it shall be located in purpose-made holes conforming to Figure 19. Where holes are to be drilled to permit routing of gas pipework, they shall be as small as possible but allow for movement. Timber-framed wall studs, rails or noggings shall not be notched.

8.11.4.5 Where horizontal pipework runs are necessary, holes shall be drilled as near as possible to the centre line of the timber member.

8.11.4.6 Any cut, notched or drilled surface of bottom plates or sole plates shall be treated with an appropriate preservative to maintain the protection originally given to the timbers before construction.

8.11.4.7 Where it is unavoidable to have live electrical cable in the same channel as the gas pipework, the cable shall be routed and clipped away from the pipework, maintaining the required minimum separation distance (see **8.4.2**). Any points of channel penetration shall be sealed with a flexible fire-resistant compound.

8.11.4.8 Where a gas supply point is to be positioned on a separating or compartment (party) wall, any pipework shall rise in front of the finished plasterboard face.

NOTE Further guidance on the fire resistance for separating or compartment walls is given in the appropriate standards or approved documents, for example Approved Document B in England [29].

8.11.4.9 Provision shall be made for pipework to accommodate any normal differential movement or shrinkage of timber construction walls.

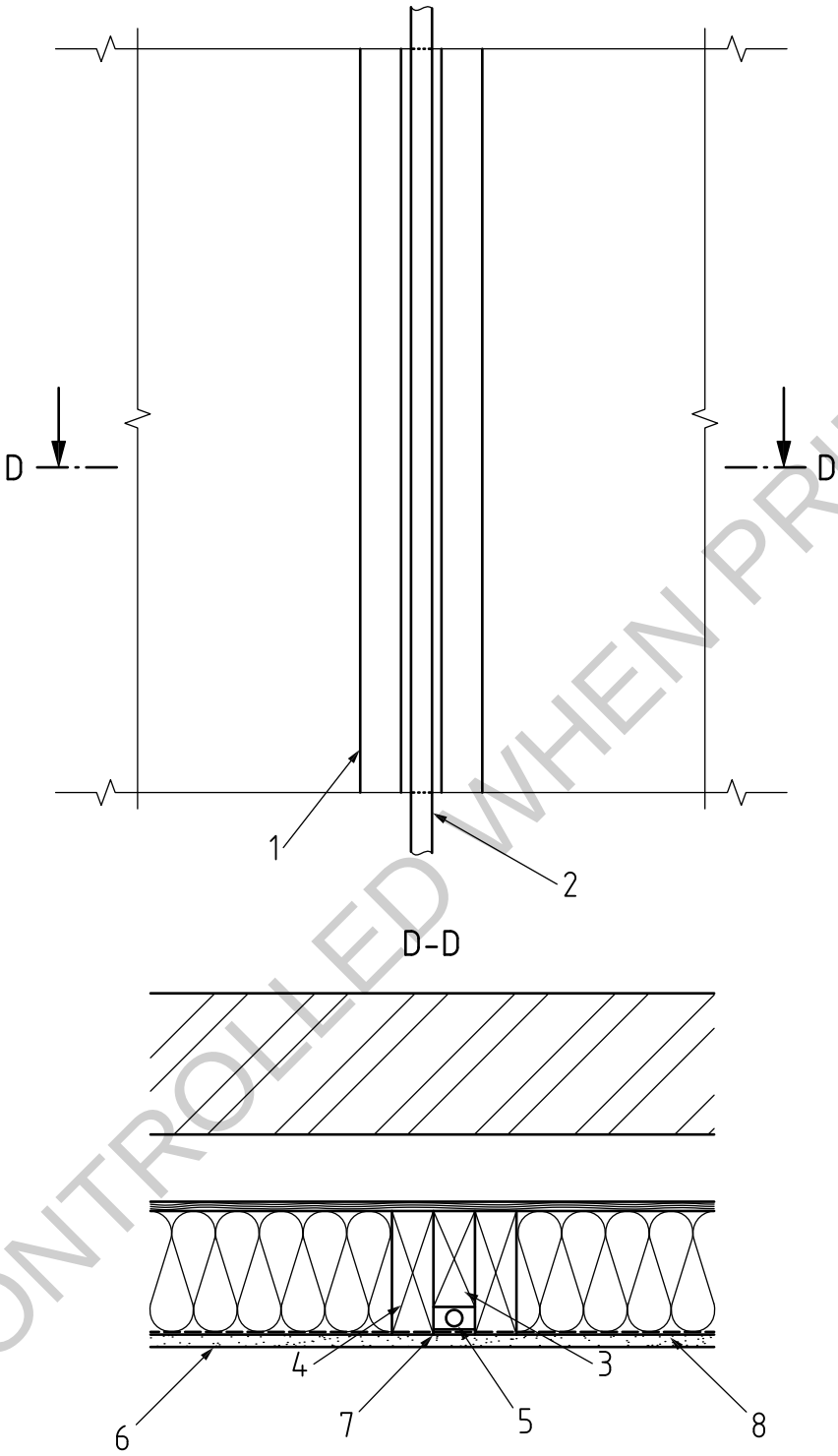
*COMMENTARY ON **8.11.4***

Typical methods of installing pipework in timber construction walls are shown in Figure 18.

This principle of applying penetration protection applies to an external or internal wall, but note that pipework in an internal wall can be within 50 mm of both sides of the wall.

Additional guidance on differential movement or shrinkage in timber-framed buildings can be found in IGEM/UP/7 [30].

Figure 18 **Typical examples of pipework installed in timber and light steel-framed construction walls**



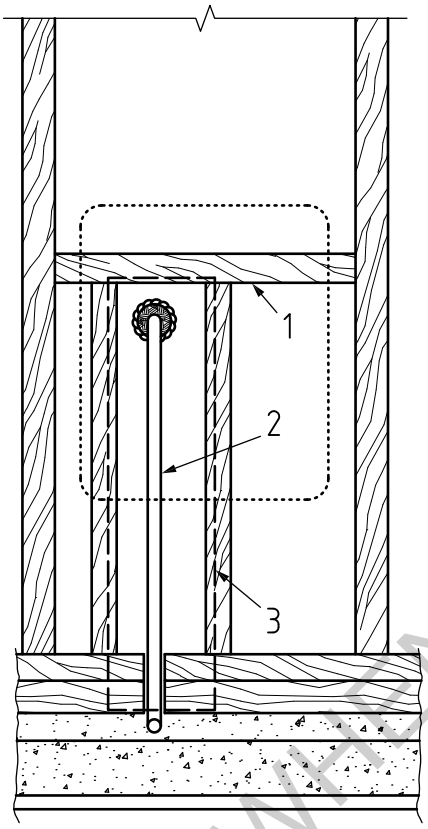
NOTE The joints between the studs should be sealed with mastic in order to avoid gas tracking around the studs.

a) Pipework passing through timber-frame wall

Key

1	Timber stud	5	Pipework
2	Pipework	6	Plasterboard
3	Timber stud blocking piece	7	Steel plate of min. 1 mm thickness
4	Timber stud	8	Vapour barrier

Figure 18 **Typical examples of pipework installed in timber and light steel-framed construction walls**



NOTE The joints between the studs should be sealed with mastic in order to avoid gas tracking around the studs.

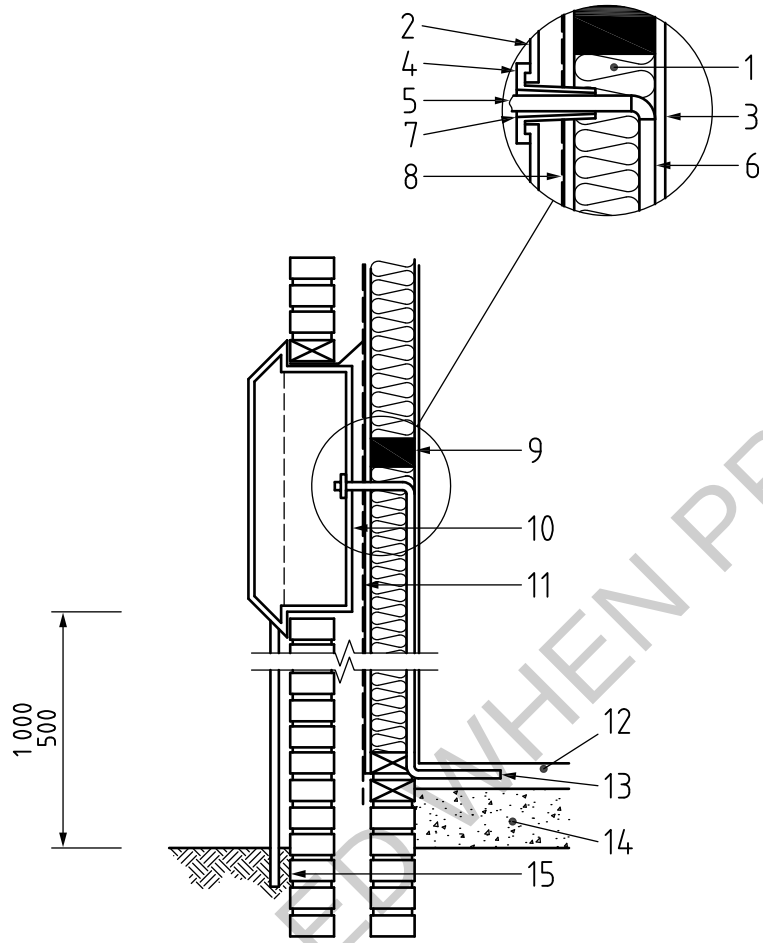
b) Pipework installed in a timber-framed wall

Key

1 Timber stud
2 Pipework
3 Steel plate of min. 1 mm thickness

Figure 18 **Typical examples of pipework installed in timber and light steel-framed construction walls**

Dimensions in millimetres



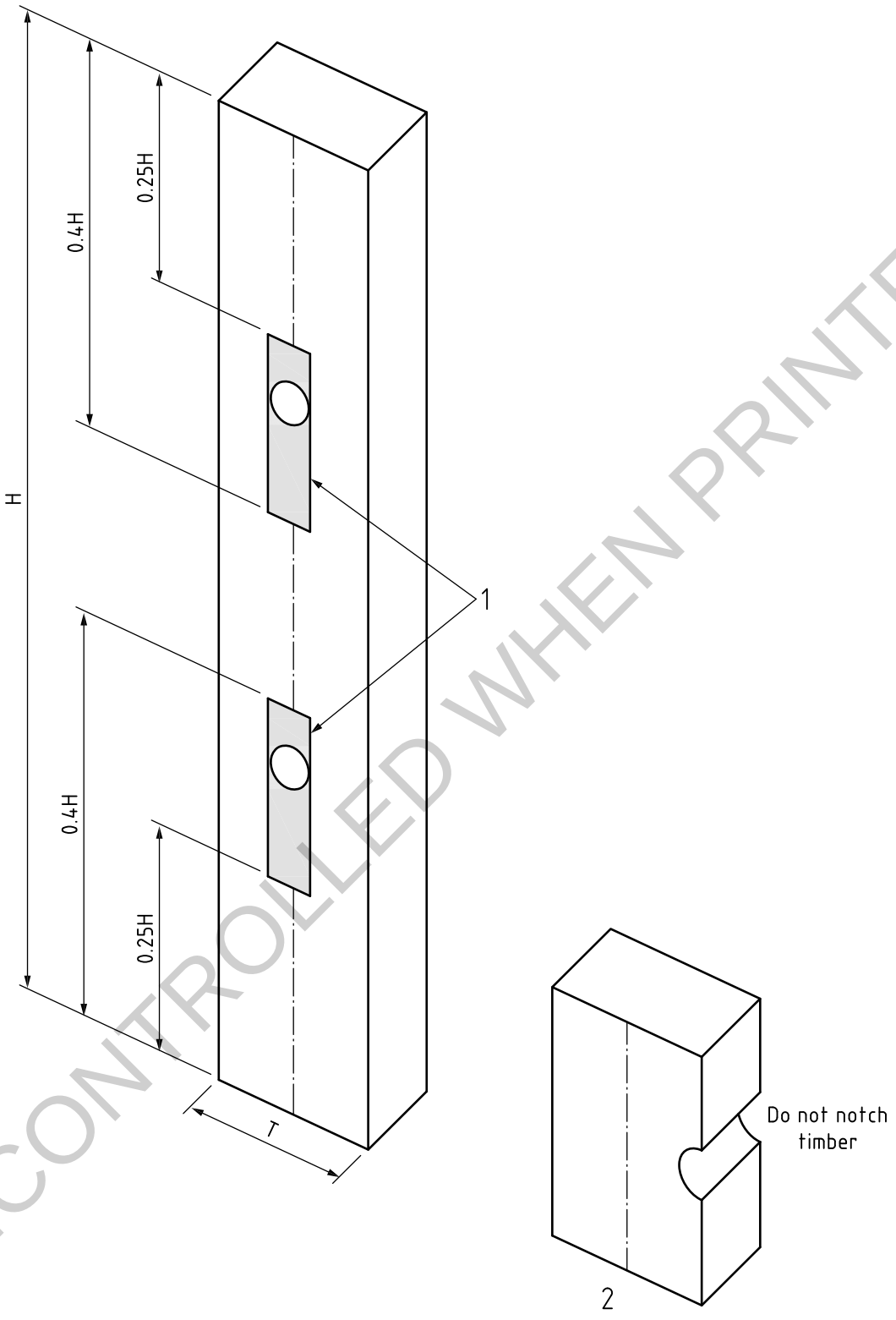
NOTE Pipework to be located in a channel formed by timber studs of the same depth as the timber frame [the principles for which are shown in Figure 18a) and b)]. Timber studs should be sealed with mastic.

c) Pipework entering a timber-framed/light steel-framed building from a meter box

Key

1 Insulation
2 Meter box wall
3 Plasterboard
4 Rear spigot
5 Pipework (protected by a steel plate of min. 1 mm thickness as necessary)
6 Vapour control layer
7 Mastic sealing
8 Timber sheathing
9 Timber stud
10 Air space between back of box and breather membrane
11 Breather membrane carried down behind meter box
12 Floor screed
13 Pipework from meter notched through sole plate
Preservative treatment to sole plate made good
14 Concrete
15 Service pipe or service pipework, as appropriate

Figure 19 **Limits for drilling of wall studding**



Key

1 Allowable zones for drilling. Maximum diameter of hole = $T \times 0.25$

2 Notching NOT acceptable in wall studding

8.12 Above-ground external pipework

8.12.1 Above-ground external pipework shall be protected against the risk of mechanical damage, e.g. in car ports.

NOTE Due to the inherent monetary value of metallic pipework, in particular copper, the risk associated with the potential theft of the pipework needs to be considered when determining the route of the pipework.

8.12.2 Above-ground external pipework shall be protected against corrosion and degradation (see **8.1.7** to **8.1.12**).

NOTE Where copper pipework is exposed to external weather conditions, it does not normally require further protection unless subjected to an additional corrosive source.

8.13 Buried external pipework

8.13.1 Buried external pipework shall be inherently resistant to, or otherwise adequately protected against, corrosion and degradation (see **8.1.7** to **8.1.12**). Steel tubes conforming to **6.2.1** and **6.2.2** shall not be buried.

8.13.2 When routing pipework, consideration shall be given to the soil type in which it is to be laid and its likely corrosion impact over time.

8.13.3 Whatever material is chosen, the design shall make allowance for any additional loading or constraint imposed by backfill or location.

8.13.4 Buried metallic pipework (other than proprietary systems intended for underground use) shall only be installed when appropriate and where:

a) a risk assessment has been carried out; and

b) an inspection strategy has been developed and provided to the gas consumer.

8.13.5 Where metallic pipework is to be buried in the ground, it shall be:

a) directly buried pre-insulated copper tube with solid covering conforming to BS EN 13349; or

b) directly buried pliable corrugated (stainless-steel) tube which:

   1) conforms to **6.2.3**;

   2) the manufacturer's instructions specifically allow direct burial;

   3) is installed in accordance with the manufacturer's instructions; and

   4) has a factory-applied cover with a minimum thickness of 0.5 mm, manufactured from a non-chlorinated material of a synthetic polymer or elastomer with a total chloride content not exceeding 50 ppm; or

c) laid inside a buried outer pipe conforming to **8.7.1** or a covered channel which terminates either above ground or in a suitable inspection pit, such as to prevent the accumulation of water in the outer pipe or duct, while still enabling periodic inspection.

NOTE Users of this British Standard are advised to consider the desirability of selecting products for which independent quality assurance certification against the appropriate product manufacture standard has been obtained.

8.13.6 Exposed metallic pipe, for example at joints, shall be further protected on site (see **8.1.7** to **8.1.12**).

8.13.7 All buried pipework shall be inspected for damage immediately prior to backfilling. Any damage shall be repaired in accordance with the manufacturer's instructions to give at least the same level of protection that was afforded before the damage.

NOTE The inspection should take account of any factory-finished protection or protection applied on site.

8.13.8 Joints shall be kept to the absolute minimum in buried sections of pipework.

8.13.9 Unless of a type specifically designed for direct burial, mechanical joints shall not be directly buried below ground. Press end connections shall not be directly buried below ground.

8.13.10 Unless of a type specifically designed for direct burial, mechanical joints in underground pipework shall be readily accessible for inspection, e.g. in an appropriate inspection chamber. Press end connections shall not be installed in underground pipework.

8.13.11 Routes shall be chosen that minimize the length of pipework required and create minimal disturbance of other underground services, e.g. existing pipework or cables.

8.13.12 Pipework shall have a minimum depth of cover as given in Table 5.

Table 5 **Buried external pipework**

Location of pipework	**Minimum depth of cover** mm
Private gardens including pathways (no vehicular traffic)	375
Private drives with light vehicular traffic	450 [A)]
Private drives where there is a likelihood of heavy traffic (such as LPG road tankers)	600 [A)]
Fields and agricultural land	1 100
Other private ground	600 [A)]

[A)] Where, due to ground conditions, it is not possible to excavate a trench to give the specified depth of cover, additional mechanical protection shall be provided above the pipe, such as burying concrete slabs below ground level at approximately 100 mm above the pipework.

8.13.13 The trench shall be excavated to firm ground at least 75 mm below the required depth. The pipework shall be laid on cohesive or granular materials that are free from sharp stones rocks, bricks or concrete (see Figure 20).

8.13.14 If appropriate, topsoil or surface materials shall be kept separate from the excavated subsoil for subsequent replacement.

8.13.15 The trench can be backfilled prior to tightness testing, but all joints and connections shall be left exposed until a satisfactory test is completed.

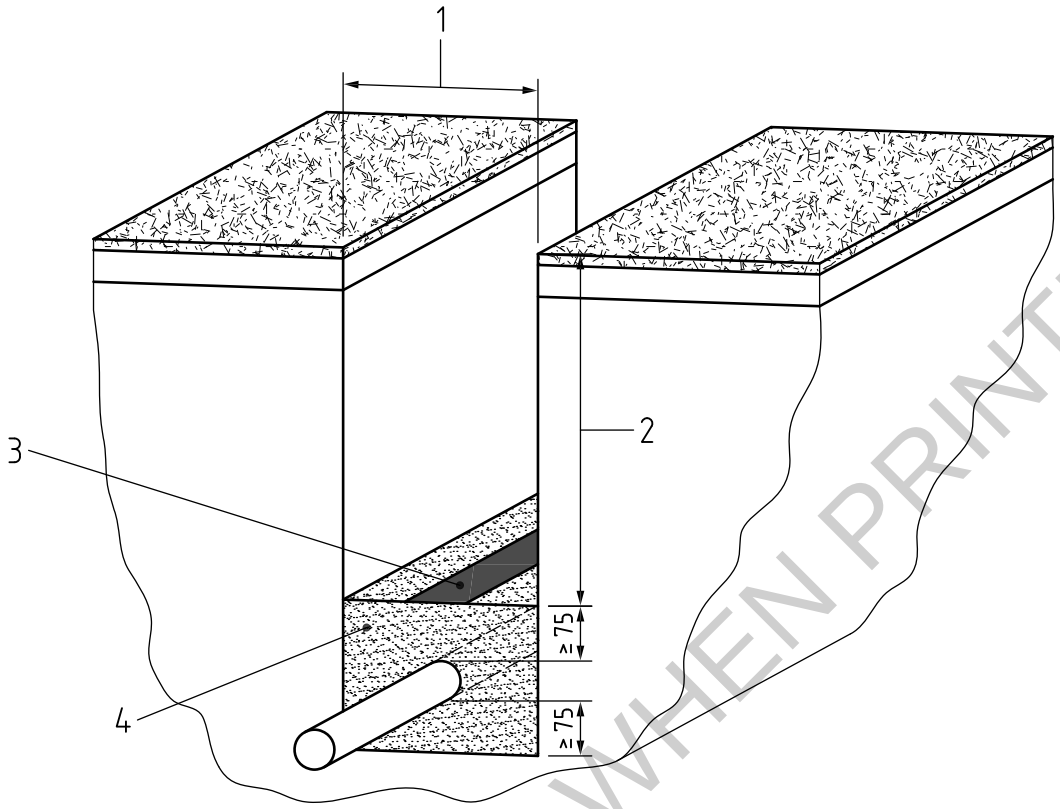
8.13.16 The backfill shall be carried out progressively in layers from one end of the pipework installation and carefully consolidated to provide firm lateral support between the pipework and the trench.

8.13.17 The backfill at the sides and immediately above the pipework shall be the same as that used for the bedding. A minimum of 75 mm of cohesive or granular material shall be backfilled above the pipework.

8.13.18 The use of wet clay shall be avoided immediately adjacent to the pipework. Fill such as hard chalk shall not be used as backfill material.

Figure 20 **Buried pipework**

Dimensions in millimetres



Key

1 Minimum spade width (allow wider for branch connections)
2 Minimum depth of cover
3 Gas marker tape 100 mm to 300 mm above pipe where necessary
4 Cohesive or granular materials (such as sand or other fine material)

8.13.19 Where cathodic protection is used, backfilling shall be carried out carefully to avoid strain being placed on electrical connections and damage to wiring between cathodic protection anodes and the pipework.

8.13.20 To facilitate future repair and maintenance, a minimum clearance of 250 mm shall be maintained between pipework, foundations and the known position of other utilities (including electric cables, etc.), unless this is not reasonably practicable (e.g. crossovers).

8.13.21 Pipework shall not be installed under the foundations of a building or in the ground under the base of a wall or footings, unless adequate steps are taken to prevent damage to the pipework in the event of the movement of those structures or the ground.

*COMMENTARY ON **8.13***

External buried pipework should, where practical, be in one length without any joints. Where necessary, the use of fittings should be kept to a minimum and, where aesthetically and practicably acceptable, bends should be used in preference to elbows.

Reference should also be made to:

a) HSG47, Avoiding danger from underground services *[31]; and*

b) National Joint Utilities Group Guidelines On The Positioning of Utilities Apparatus For New Development Sites *[32].*

Further information on pipework is given in UKLPG Code of Practice 22 [20] and IGEM/TD/4 [33].

8.14 Identification of buried external pipework

A yellow plastic indicator tape (marked "gas") shall be laid between 100 mm and 300 mm above the pipework, unless:

a) the route of the pipework is adequately recorded or marked, or is obvious; or

b) other means are available for pipework location.

NOTE Where employed, it is preferential for the indicator tapes for polyethylene pipework to incorporate a metallic core wire to permit the pipework route to be identified by a suitable instrument.

8.15 Additional requirements for the installation of polyethylene (PE) pipework

*NOTE The requirements of this subclause are additional to those of **8.12**, **8.13** and **8.14**.*

8.15.1 PE pipework and fittings shall only be used for external pipework.

8.15.2 PE pipework and fittings shall not be subjected to prolonged exposure to sunlight or other ultraviolet (UV) sources.

8.15.3 PE pipework and fittings shall not be used above ground, except to rise vertically to allow the transition to metallic pipework, which shall be as close as practicable to the external ground level.

8.15.4 PE pipework and fittings above ground level shall be shrouded from sunlight and other ultraviolet (UV) sources and mechanical damage. Where PE pipework and fittings are installed above ground, provision shall be made to protect the pipe from such sources, for example by enclosing the pipe in a glass-reinforced plastic sleeve, a steel sleeve or another sleeve manufactured from a UV-stabilized material.

8.15.5 Solvent welding shall not be used.

*COMMENTARY ON **8.15***

Additional information on the installation of PE pipework can be found in the Institution of Gas Engineers and Managers publication IGEM/TD/4 [33].

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

It is preferable to use metal gas pipework entries into buildings. The Gas Safety (Installation and Use) Regulations [1] require that where PE pipework is used to enter the building, that part of it within the building is placed within a metal sheath which is constructed and installed so as to prevent, as far as practicable, gas escaping into the building if the pipework fails.

It is essential that care be taken to ensure that pipework designed for carrying water is not used for gas installations. Also, plastics pipes designed to distribute water in both domestic hot/cold water and central heating systems, whether or not they contain a metallic barrier, are not suitable for use for gas installations.

8.16 Pipework in ducts

8.16.1 Ventilation

8.16.1.1 Vertical and horizontal ducts containing pipework shall be ventilated to ensure that minor gas leakage does not cause the atmosphere within the duct to become unsafe.

8.16.1.2 Any ventilation opening shall be located such that air movement can occur within the duct.

8.16.1.3 Any ventilation opening shall lead to a safe place, preferably to outside air.

8.16.1.4 Ducts shall be sealed from any cavity, wall or floor void through which they pass.

*COMMENTARY ON **8.16.1***

The duct can 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 sized in accordance with Table 6 [see Figure 22a)].

A duct, or an isolated section of duct contained solely within a room or space, can be ventilated within that room or space, provided the room or space is ventilated to normal occupational standards.

Table 6 **Free area of ventilation openings**

Cross-sectional area m^2	**Minimum free area of each opening** [A)] m^2
Not exceeding 0.01	0
0.01 and not exceeding 0.05	Cross-sectional area
0.05 and not exceeding 7.5	0.05
Exceeding 7.5	1/150 of the cross-sectional area

[A)] For vertical shafts and ducts the required openings should be provided at both high and low level. For horizontal ducts and ceiling voids the required openings should be provided at either end.

Additional information is given in BS 8313.

Ducts having a small cross-sectional area and volume (i.e. 0.01 m^2 or less with a total volume of less than 0.1 m^3) are considered to be adequately ventilated by adventitious means and no additional openings are required.

The level of ventilation is not intended to clear a major gas escape arising from damage or failure of gas pipework

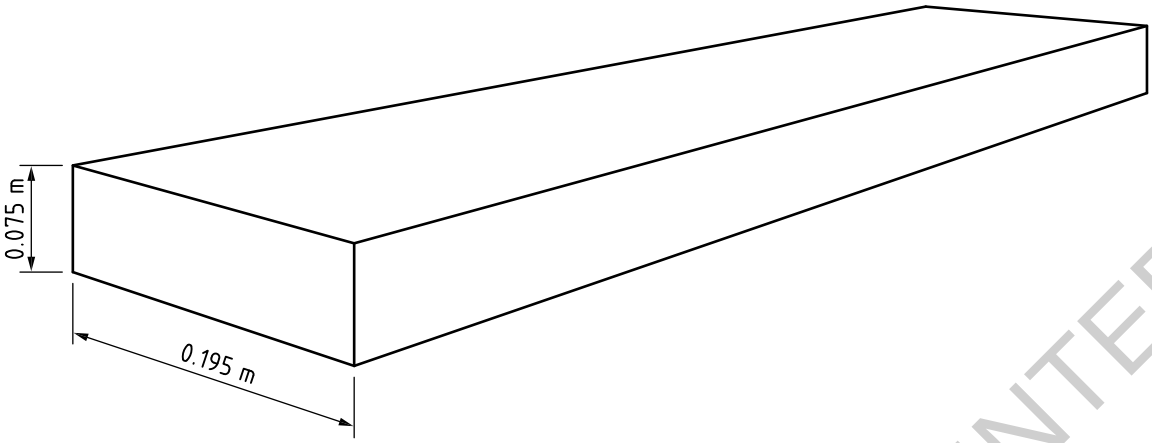
Cross-sectional area is as indicated in Figure 21.

8.16.2 Fire resistance

The fire resistance of any duct containing pipework shall have a fire rating equal to or greater than any void through which it passes.

NOTE See Approved Document B to the Building Regulations [29] for further guidance.

Figure 21 **Cross-sectional area of duct**



NOTE Cross-sectional area of duct is measured perpendicular to its longest length: 0.075 m × 0.195 m = 0.0146 m²

8.17 Multi-occupancy buildings

Where pipework passes through an individual dwelling/commercial unit other than the one it supplies, it shall be located in a purpose-provided duct designed and constructed to prevent damage to the pipework [see Figure 22b)].

NOTE The Building Regulations [5], [6] and [7] also contain provisions for the design and construction of such ducts.

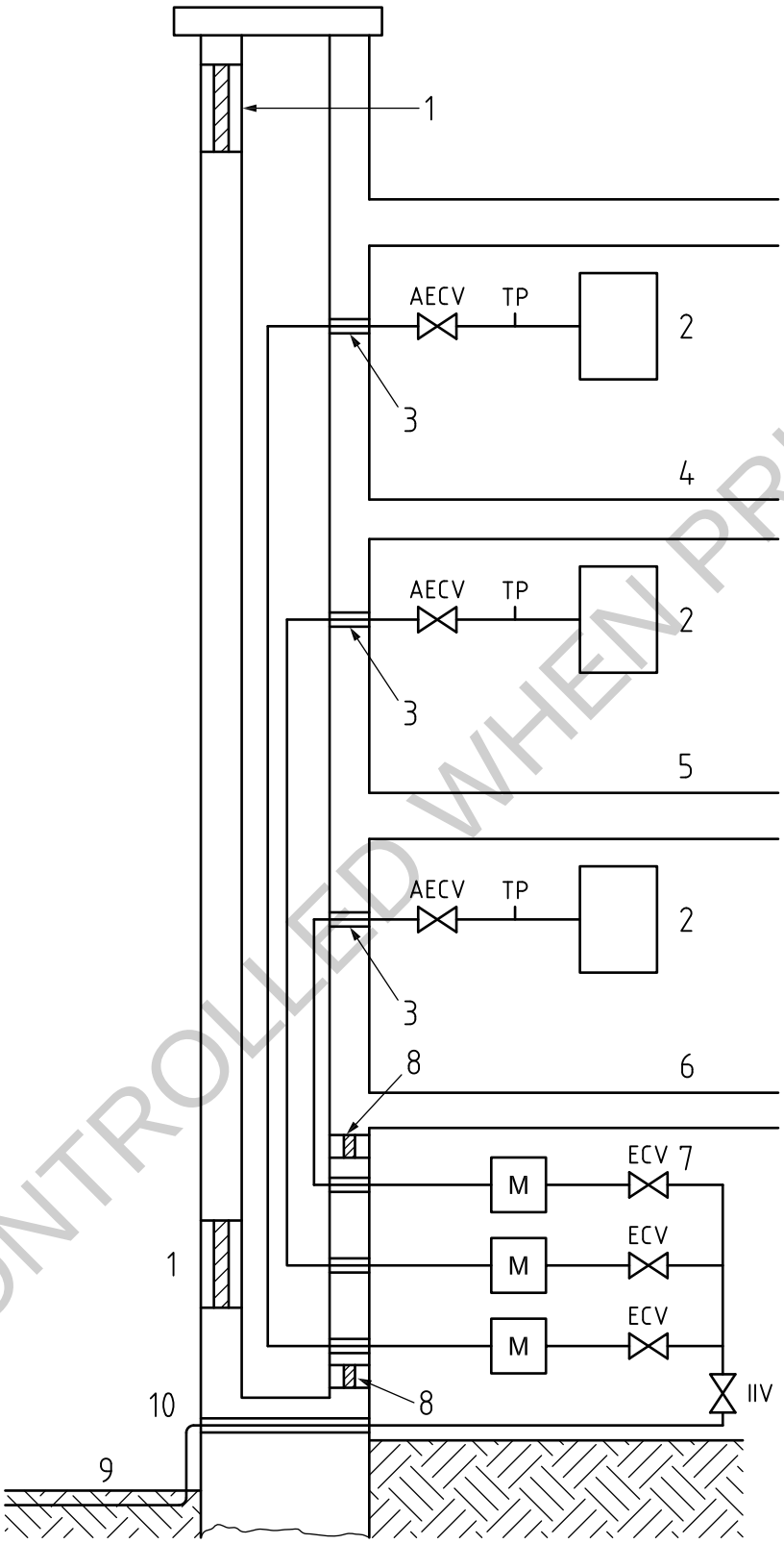
8.18 Fire stopping

For buildings containing flats and/or maisonettes, pipework shall be fire-stopped as it passes from one floor to another, unless it is installed in its own protected shaft that is ventilated top and bottom to outside air. When pipework from a protected shaft enters a flat or maisonette, it shall be fire-stopped at the point of entry [see Figure 22a)].

*COMMENTARY ON **8.18***

When pipework passes 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 pipework 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 applicable part of BS 476, achieve the relevant periods of fire resistance for the structure in respect of load bearing capacity, integrity and insulation.

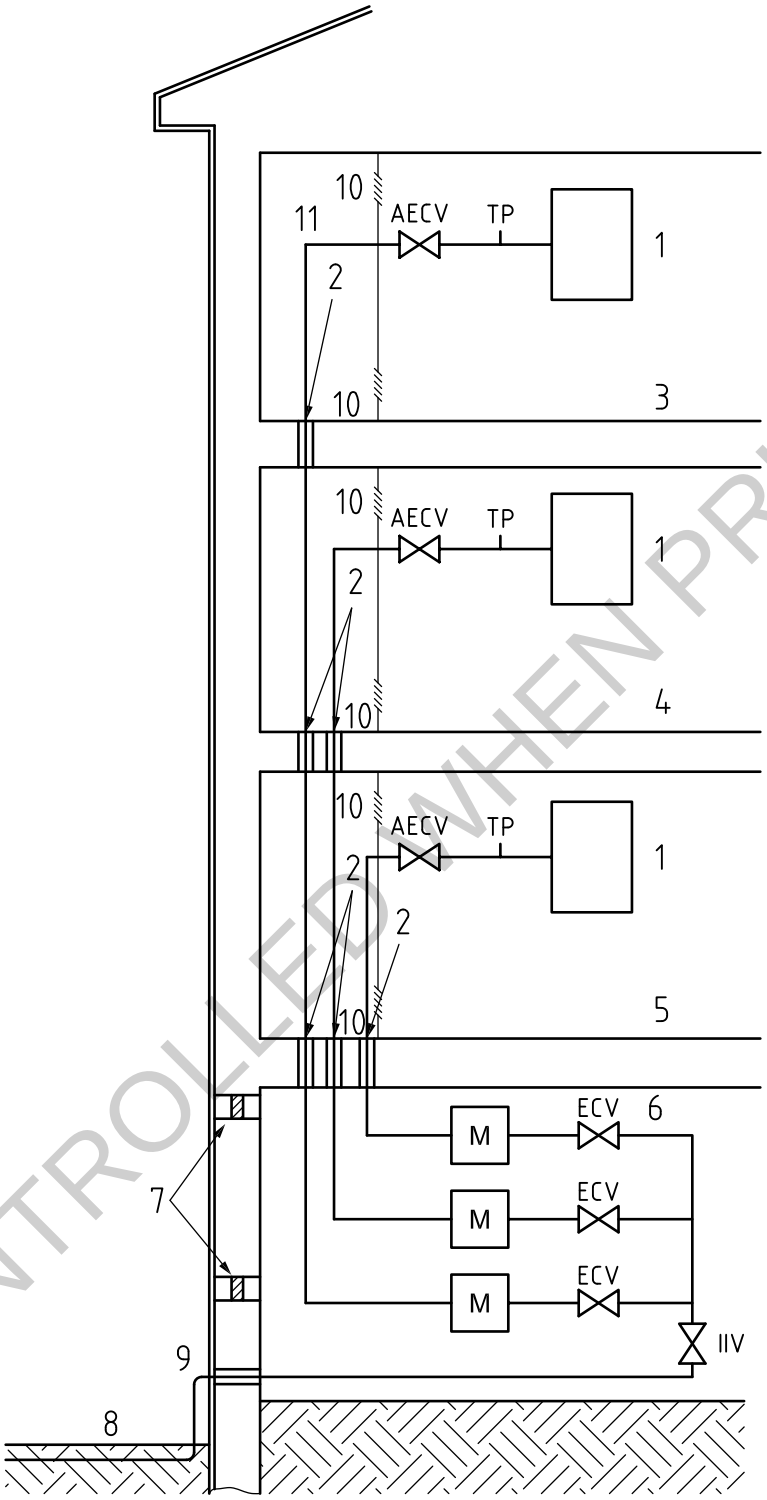
Figure 22 **Typical pipework in multi-storey buildings containing flats or maisonettes** *(1 of 2)*



a) Ventilated duct

Key	1	Ventilation	6	Flat 1	ECV	Emergency control valve
	2	Appliance	7	Meter room	AECV	Additional emergency control valve
	3	Fire stop	8	Meter room ventilation	IIV	Inlet isolation valve
	4	Flat 3	9	Ground level	M	Gas meter
	5	Flat 2	10	Gas service	TP	Test point

Figure 22 **Typical pipework in multi-storey buildings containing flats or maisonettes** *(2 of 2)*



b) Fire stopped pipework and ventilated enclosed area

Key	1	Appliance	6	Meter room	11	Enclosure
	2	Fire stop	7	Meter room ventilation	ECV	Emergency control valve
	3	Flat 3	8	Ground level	AECV	Additional emergency control valve
	4	Flat 2	9	Gas service	IIV	Inlet isolation valve
	5	Flat 1	10	Vent	M	Gas meter
					TP	Test point

NOTE Vents are to communicate with an area that is ventilated in accordance with the Building Regulations [5], [6], [7].

8.19 Gas pipework inside a protected area (see Annex D)

8.19.1 In addition to the requirements for fire resistance (see **8.16.2**) and fire stopping (see **8.18**) any pipework carrying gas installed in, or passing through, a protected area shall be:

a) steel pipework with screwed joints;

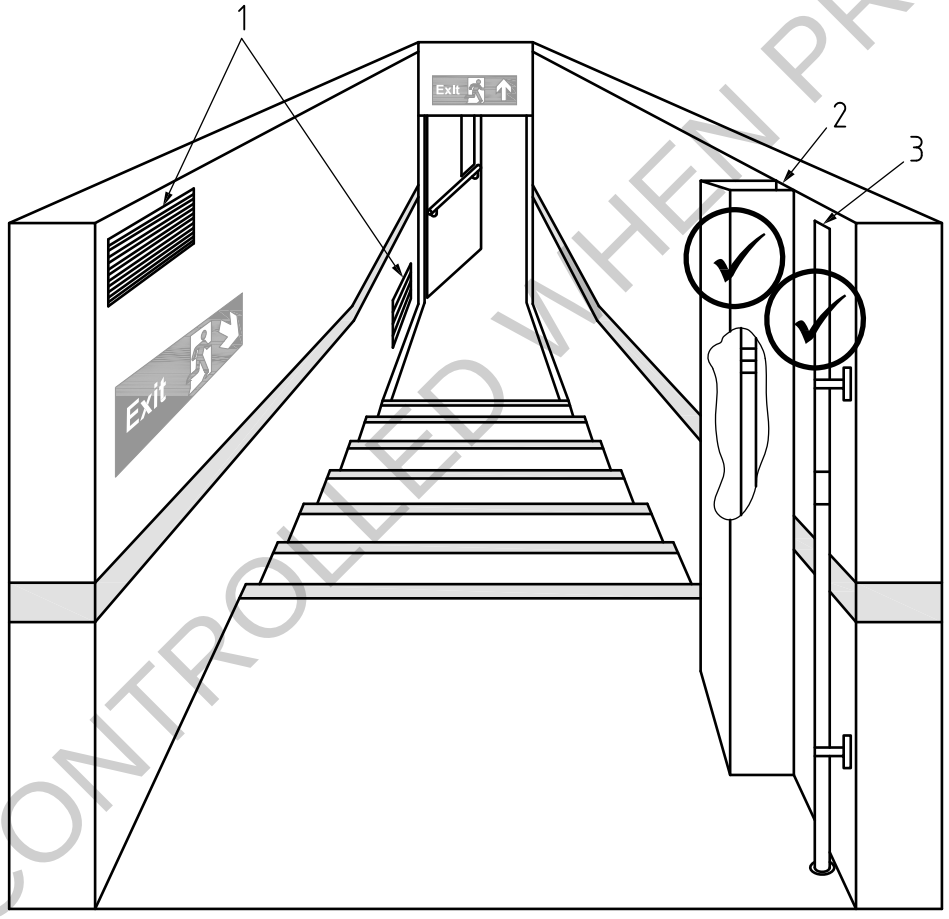
b) steel pipework with welded joints;

c) continuous length of copper (no joints); or

d) continuous length of pliable corrugated (stainless-steel) tubing manufactured to withstand fire test A of BS EN 1775:2007, Annex A.

NOTE See Figure 23. Pliable corrugated (stainless-steel) tubing manufactured to BS 7838 meets fire test A. For pliable corrugated tubing manufactured to BS EN 15266 the manufacturer should be consulted.

Figure 23 **Copper and steel pipe in a protected area**



Key

1 Vent direct to outside air (see **8.19.2**).

2 Pipe not conforming to **8.19.1**, e.g. jointed copper gas installation pipe, within its own fire-rated duct which is ventilated in accordance with **8.19**.

3 Pipe conforming to **8.19.1**, e.g. steel pipe with screwed joints.

8.19.2 Other than the exceptions described in **8.19.3** to **8.19.5**, a protected area containing pipework shall be ventilated at high and low levels direct to the outside air. Sizes of ventilation openings shall be in accordance with Table 6. Mechanical ventilation shall not be used to achieve the required ventilation levels.

*COMMENTARY ON **8.19.1** AND **8.19.2***

Pipework is not considered to be contained within a protected area if the pipework is completely separated from that protected area by fire-resisting duct, which itself is ventilated direct to outside air, e.g. a service shaft.

Ventilation grilles (including intumescent grilles) are not to be provided in fire doors or partitions dividing one protected area from another, such as between a corridor/lobby and stairway, as this could lead to smoke leakage into the escape stairway in the event of a fire.

The fire/acoustic performance of a suspended ceiling should be confirmed with the building designer or the local building control body.

Further guidance on protected areas is given in the appropriate Building Regulations [5], [6], [7] and other applicable building standards.

*Subclauses **8.19.1** and **8.19.2** do not normally apply to one or two storey domestic dwellings.*

8.19.3 Pipework within a protected corridor/lobby, including any suspended ceiling void above the protected area, can be contained within a duct which is vented to outside air either directly or indirectly via another ventilated area. Any ducting shall be of fire-resisting construction to the level of the fire resistance of the protected area it passes through or of an alternative material with fire stopping where the duct passes through the compartment walls/floors.

8.19.4 Pipework that is continuous or welded and meets the requirements of **8.19.1**b), c) or d) can be installed within a protected corridor/lobby which is not ventilated direct to outside air, provided the protected corridor/lobby is normally occupied. If the pipework is installed above a suspended ceiling, which does not form part of the required fire/acoustic performance of the compartment floor, the ceiling void can be vented into the normally occupied protected corridor/lobby via vents inserted through the ceiling. These vents shall be sized and installed in accordance with **8.16.1** and Table 6.

NOTE The term "normally occupied" means an area in which it is reasonably expected that passers-by will be in the vicinity, e.g. regularly used common corridors or common lobbies.

8.19.5 Pipework conforming to **8.19.1**a) installed above a suspended ceiling which does not form part of the required fire/acoustic performance of the compartment floor can be vented into the corridor via vents inserted through the ceiling, provided the corridor is ventilated direct to outside air. These vents shall be sized and installed in accordance with **8.16.1** and Table 6.

8.19.6 If the gas pipework is within a duct and any inspection hatch or door opens from that duct into a protected area, that hatch or door shall be of at least the same fire rating as the protected area in which it is fitted and suitably sealed on all edges to contain any gas escape within the duct.

NOTE The seals to be used should enable the hatch or door to be opened without compromising the integrity of the seal when the hatch or door is closed.

8.20 Additional requirements for pipework inside timber-framed and light steel-framed buildings

8.20.1 If the pipework is being run within the inner leaf of an external timber-framed or light steel-framed wall, the pipework shall be installed in accordance with **8.11.4** and routed as close as possible to the plasterboard side and in a channel within the timber frame, i.e. on the warm side of the insulation.

8.20.2 Where installing pipework through a vapour control layer (VCL), any hole cut in the VCL shall be as small as possible to accommodate the pipework/sleeve. Where the VCL is a polythene membrane, the hole in the VCL shall be 10 mm smaller than the pipework/sleeve so that it makes a tight interference fit around. Any perforations of the VCL shall be made good with an adhesive tape.

8.20.3 The plasterboard shall be made good with plaster or flexible fire-resistant compound so that there is no route for air movement into the inner leaf framework.

8.20.4 When forming channels in previously constructed walls the channel shall be re-instated so that the insulation, VCL and plasterboard are to the same standard as the rest of the wall.

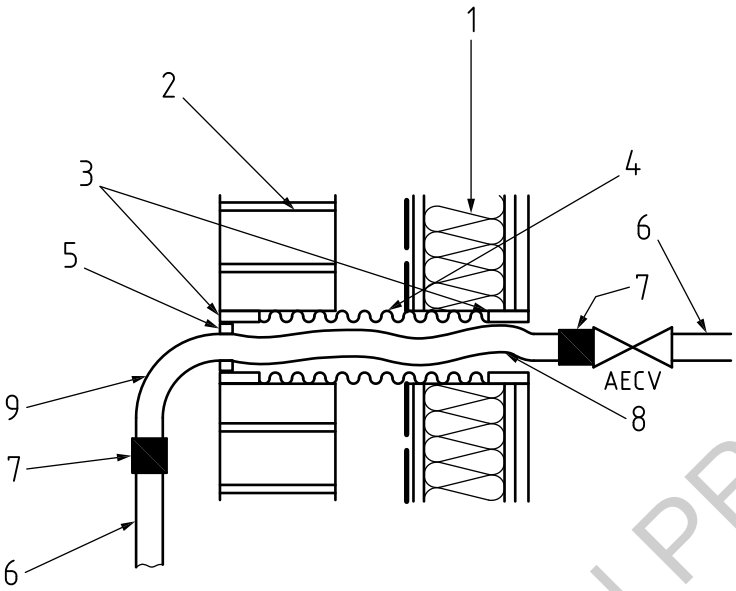
8.20.5 Provision shall be made for pipework to accommodate any normal differential movement or shrinkage of the building, with special attention being given to buildings of multi-storey construction.

*COMMENTARY ON **8.20***

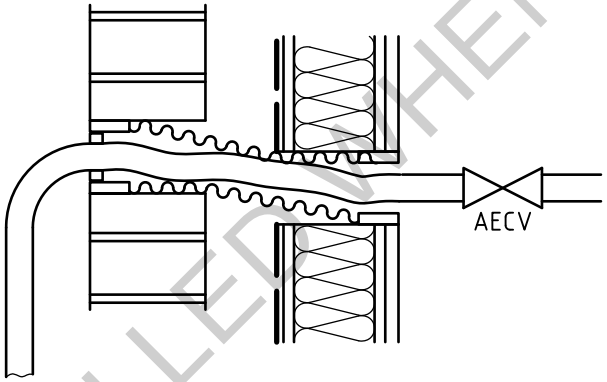
Additional guidance on differential movement or shrinkage in timber-framed and light steel-framed buildings can be found in IGEM/UP/7 [30] and IGEM/G/5 [34].

A suitable method of accommodating movement for gas pipework passing through a masonry wall is given in Figure 24.

Figure 24 **Typical method of accommodating movement for pipework passing through a masonry/timber-frame wall**



a) As installed: before movement of timber



b) After relative movement of timber

Key

1 Timber frame
2 Masonry external wall or wall of internal riser duct
3 Sealant between sleeve and wall
4 Flexible pipe sleeving
5 Flexible sealant on one end of sleeve only, preferably external side to prevent water ingress
6 Rigid pipe
7 Transition fitting from rigid pipework to pliable corrugated (stainless-steel) tubing
8 Pliable corrugated (stainless-steel) tubing
9 Bend not to exceed manufacturer's recommendation

9 Installation of flexible hoses, tubing, assemblies and their connections

*COMMENTARY ON CLAUSE **9***

This clause does not cover the requirements for hoses, tubing, assemblies and their connections that are used as the final connections to moveable gas appliances. These are covered by the appropriate appliance installation standards.

9.1 General

9.1.1 Flexible hoses, tubing and associated assemblies shall only be used for:

a) LPG cylinder-mounted regulator connections – the connection between a cylinder-mounted regulator and the fixed pipework installation; and

b) residential park home and caravan holiday home connections – the connection between an ECV, AECV, meter or a regulator/changeover device sited remotely from a residential park home or caravan holiday home on a standpipe/upstand and the fixed pipework installation.

NOTE For details on the requirements for the installation of high-pressure hoses, tubing, assemblies and their connections between a cylinder vapour valve and a regulator/changeover device, see BS 5482-1, BS 5482-2 or UKLPG Code of Practice 24 [35]. For details on the requirements for the installation of standpipe/upstands, see IGEM/G/6 [36].

9.1.2 Where a flexible pipework connection is used it shall be of one continuous length and be as short as practicable to provide the flexibility for which it is to be utilized. The length of the flexible pipework connection shall be sufficient to prevent excessive strain on it or its end connections and to allow smooth swept bends without kinking (see **9.2** and **9.3**).

9.1.3 Where necessary, flexible pipework connections shall be supported.

9.1.4 Flexible pipework connections shall not be used if, when inspected, they show any signs of any physical damage, environmental deterioration or service failure.

NOTE Examples include:

- *physical damage, such as cuts or abrasion, cracking, stretching, flattening, kinking and, where fitted, missing/worn sealing washers, damaged cylinder connections;*
- *environmental deterioration, such as stiffening, cracking, delamination of outer covering, chemical degradation, i.e. softening of outer coating by contact with oil; and*
- *service failure, such as blistering, soft spots, rupture and, for preassembled end fittings, corrosion or loosening of swaged fittings attaching hose.*

9.1.5 Where flexible pipework connections are used, electrical continuity shall be maintained where applicable.

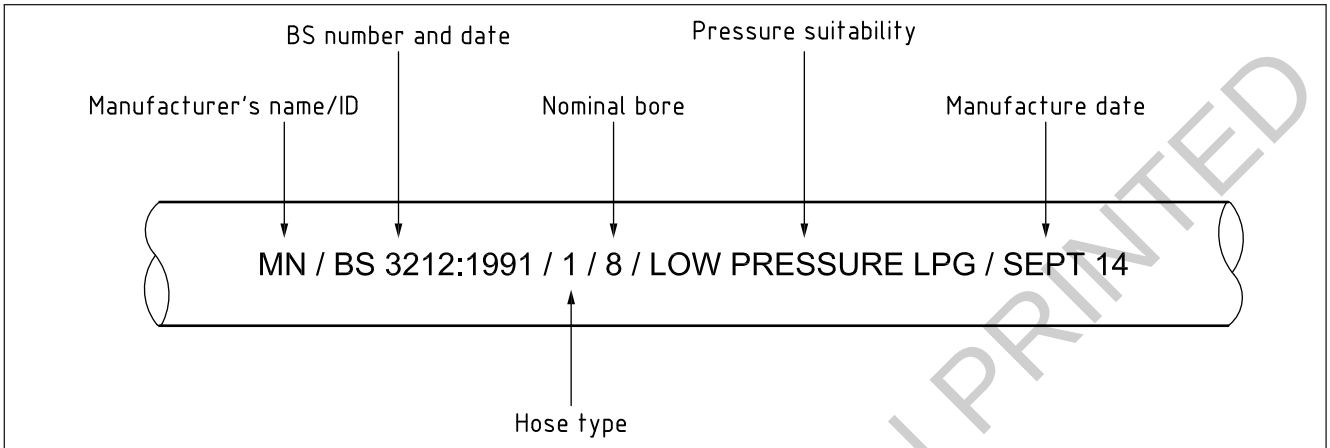
9.1.6 Flexible pipework connections shall not be used where they could be subjected to temperatures in excess of 50 °C, unless specifically designed for that application.

9.1.7 Flexible pipework connections shall not pass through walls, floors, ceilings or other partitions.

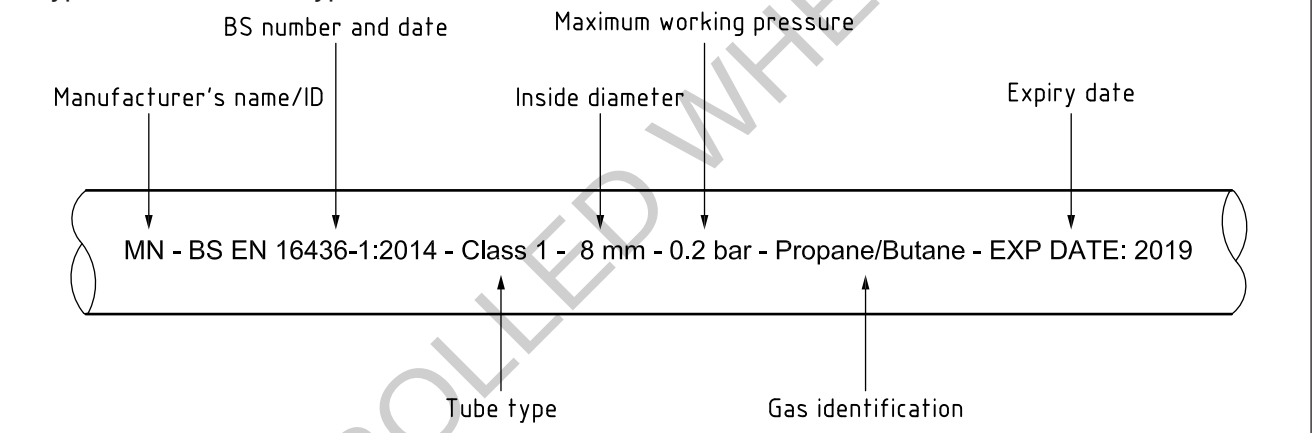
9.1.8 Flexible hoses, tubing and their associated assemblies conforming to BS 3212, BS EN 1763-1 or BS EN 16436-1 shall be marked in accordance with the appropriate standard.

NOTE Examples of typical marking on hoses and tubing manufactured to these standards is illustrated in Figure 25.

Figure 25 **Identification of hoses, tubing and assemblies for use with LPG**



a) Typical BS 3212 hose type identification



b) Typical BS EN 16436-1, Class 1 tube type identification

9.1.9 Flexible tubing conforming to BS EN 16436-1 shall not be used after the declared expiry date.

*COMMENTARY ON **9.1.9***

Whilst no expiry date, specific service life or exchange interval is specified for flexible hoses, tubing and associated assemblies in BS 3212 or BS EN 1763-1, it is unlikely that the service life would exceed 10 years and therefore replacement at this age is recommended. For hoses conforming to BS EN 16436-1 (class 2 and 3) no expiry date, specific service life or exchange interval is currently specified and it is unlikely that the service life would exceed 10 years, so replacement at this age is recommended. Requirements relating to expiry date for these class 2 and 3 hoses will be given in BS EN 16436-2 (when published).

9.1.10 Flexible hose or tubing shall only be connected to an appropriate and suitably-sized fitting or nozzle.

*NOTE Traditional nozzles used on LPG installations, such as the "Fulham Nozzle", are known to have high-pressure losses across them, and these pressure losses along with the internal diameter of any flexible hose or tube need to be considered in the design process specified in Clause **5**.*

9.1.11 Flexible hose or tubing with an internal diameter of 8 mm or greater and operated at a pressure of up to, but not exceeding, 50 mbar shall be secured using either crimp clips or swaged fittings or worm drive clips. Only crimp clips of the correct size for the hose or tubing shall be used. Worm drive clips shall secure hose or tubing but shall not be over-tightened.

9.1.12 Flexible hose or tubing with an internal diameter of less than 8 mm and hose operated at a pressure exceeding 50 mbar shall always be secured by crimp clips or swaged fittings. Worm drive clips shall not be used.

9.2 LPG cylinder-mounted regulator connections

For installations other than those specified in **9.3**, the length of the flexible pipework connection between the cylinder regulator and the fixed pipework shall be limited to a maximum length of 500 mm.

9.3 Residential park home and caravan holiday home connections

9.3.1 The flexible pipework connection between the standpipe/upstand-mounted ECV, AECV, meter or regulator/changeover device and the fixed pipework installation shall only be made once the residential park home or caravan holiday home has been fully sited.

9.3.2 Movement of the residential park home or caravan holiday home due to settlement, thermal expansion, structural flexing or wind loading, and its potential effects on the gas pipework and attached equipment, shall be accommodated by installing an appropriate flexible pipework connection with a minimum length 300 mm between any standpipe/upstand installation and the fixed pipework installation. The length of the flexible pipework connection shall be limited to the minimum possible exceeding 300 mm, with a maximum length that shall not exceed 2 m (see the exception in **9.3.5**).

NOTE Usually, a caravan holiday home or residential park home is designed to be stable, with limited vertical movement with respect to the ground.

Any standpipe/upstand is required to be sited as close as practicable to, and not further than 1 m from, the residential park home and caravan holiday home it serves. See IGEM/G/6 [36].

9.3.3 Flexible pipework connections shall not be used with the intention to increase the distance of a residential park home or caravan holiday home from its connection to a standpipe/upstand-mounted ECV, AECV, meter or regulator/changeover device.

9.3.4 Where flexible hoses, tubing and associated assemblies conforming to BS 3212, BS EN 1763-1 or BS EN 16436-1 are used, they shall be armoured against rodent attack.

9.3.5 Where a flotation device is fitted to a residential park home or caravan holiday home so that a longer flexible pipework connection might be required, the length of flexible pipework connection shall be sufficient to accommodate the movement of the home permitted by the flotation device.

9.3.6 Where the residential park home or caravan holiday home is not sufficiently anchored, any uncontrolled release of gas caused by movement or overturning through high winds or flooding shall be limited by including a quick release, self-sealing coupling with an integral anchored release sleeve.

NOTE The length of pipework and number of fittings between any quick release coupling and the flexible connection should be minimized. IGEM/UP/2 [12] contains the detail of an acceptable coupling for this purpose.

10 Commissioning

10.1 General

Where the appliance input is range or variable-rated, the installer shall permanently mark on the appliance the actual heat input at which the appliance is to be set.

10.2 Gas tightness testing and purging

Upon completion, the installation shall be tested for gas tightness and purged in accordance with the appropriate standard.

NOTE For the majority of installations the appropriate standard is IGEM/UP/1B [23], but alternatively IGEM/UP/1 [21] or IGEM/UP/1A [22], as appropriate, can be utilized.

10.3 Meter, regulator and safety devices

10.3.1 Natural gas meter installations shall be installed and commissioned in accordance with BS 6400-1 and BS 6400-2, IGEM/GM/6 [10] or IGE/GM/8 [11], as appropriate.

10.3.2 LPG meter installations shall be installed and commissioned in accordance with BS 6400-3.

10.3.3 On LPG installations that do not incorporate a meter immediately downstream of the regulator, the regulator shall be installed in accordance with Annex E and commissioned in accordance with a) and b).

NOTE 1 Many LPG regulators and associated safety devices are factory-preset to deliver the required pressures and operate within specific tolerances. They should not require further adjustment during their service life on site. Adjustments of such regulators and associated safety devices might affect their safe operation and invalidate any warranties.

a) The installer shall ensure the operating pressure at the outlet of the regulator is within the tolerances indicated in Table 7 at a flow rate not exceeding the maximum flow rate of the regulator.

   NOTE 2 When checking a regulator on site, it is important that a sufficient gas flow rate is obtained. Where appliances have already been installed and commissioned, this can be achieved by operating all appliances at full gas flow rate. Where no appliances are installed and commissioned, this can be achieved by using a device that allows a flow rate of at least 0.5 m^3/h.

   At low flow rates the operating pressure can tend towards the higher values in Table 7 and at high flow rates operating pressure can tend towards the lower values.

b) The installer shall ensure that the regulator locks up at a pressure not exceeding the values given in Table 7, with no flow through the installation.

Table 7 **Operating pressure (LPG)**

Fuel	Nominal outlet pressure mbar	Minimum outlet pressure mbar	Maximum outlet pressure mbar	Maximum lock-up pressure (above set pressure) mbar
BS 3016 – Cylinder single stage regulator set pressures:				
Butane	28	23	33	+10
Propane	37	32	42	+15
BS 3016 – Final (second) stage regulator set pressures (low pressure):				
Propane	37	32	42	+10
BS 3016 – Cylinder automatic changeover device set pressures (low pressure):				
Propane	37	32	42	+15
BS EN 12864 or BS EN 16129 – Cylinder single stage regulator set pressures:				
Butane	29	22	35	40
Propane	37	27 [A)]	45	50
BS EN 13785 or BS EN 16129 – Final stage regulator set pressures (low pressure):				
Propane	37	32 [B)]	45	50
BS EN 13786 or BS EN 16129 – Cylinder automatic changeover device set pressures (low pressure):				
Butane	29	22	35	40
Propane	37	27 [A)]	45	50

[A)] Value is the minimum outlet pressure specified in the regulator standard to align with BS EN 437. However, it is recommended that for the UK market the minimum operating pressure for propane regulators is 32 mbar.

[B)] Due to the UK-agreed UPSO range the minimum outlet pressure for regulators manufactured for the UK market is taken as 32 mbar NOT the 27 mbar declared in BS EN 13785 or BS EN 16129.

10.3.4 The functional operation of the relief valve, the under-pressure shut-off (UPSO) and the over-pressure shut-off (OPSO) shall be tested in accordance with the manufacturer's testing procedures where the manufacturer provides such instruction.

*COMMENTARY ON **10.3.4***

The operational set pressures for the relief valve, the UPSO and the OPSO, are factory-preset and tested by the manufacturer in accordance with the appropriate manufacturing standard on specific test rigs. Functional onsite tests to confirm setting pressures for these controls is not normally practical unless specified by the manufacturer with a supporting testing procedure. It is only deemed necessary to test the functional operation of these controls if the control manufacturer provides a supporting procedure. In these situations the controls should be tested in accordance with the manufacturer's instructions provided.

*See also **10.3.3**.*

10.3.5 If any of the checks or tests in **10.3.4** or **10.3.6** are outside the acceptable range and/or are unsuccessful:

a) if the regulator and associated safety devices are of a type that can be adjusted, they shall be adjusted by a person authorized by the LPG supplier in accordance with manufacturer's instructions; or

b) if the regulator and associated safety devices are of a type that cannot be adjusted, the complete regulator and/or associated safety devices shall be replaced.

*COMMENTARY ON **10.3.5***

Regulation 14(6)(b) of the Gas Safety (Installation and Use) Regulations 1998 [1] requires that no person except the LPG supplier, or a person authorized to act on the supplier's behalf, is to break a seal on a regulator controlling the pressure of gas from a gas storage vessel.

*See also **10.3.3**.*

10.3.6 The installer shall ensure that the regulator and safety device(s) are sealed to prevent their settings from being interfered with without the seal being broken.

10.4 Confirmation of adequacy of pipework sizing

When appliances are connected, it shall be confirmed that the pipework is adequate to ensure that all appliances connected operate at their required heat input in accordance with the appliance manufacturers' instructions.

*COMMENTARY ON **10.4***

Due to the overall inaccuracies inherent in typical methods of onsite testing, to confirm that the design pressure loss is achieved, a physical check of actual pressure losses between two specified points on an installation is not required.

Where there is a concern that there might be an excessive pressure loss, the operating pressure at the primary meter outlet or, where no meter is fitted, the regulator outlet should be checked to confirm that this is within acceptable tolerances. Where a meter is installed, a check should then be carried out to confirm that the individual appliance(s) heat input is in accordance with the appliance manufacturer's specification. Where multiple appliances are installed, this check should be repeated with all appliances in operation to confirm the total of all appliance heat inputs is achieved. Where no meter is installed on an LPG installation, it is necessary to confirm the appliance(s) operating pressure is in accordance with the appliance manufacturer's specification with all appliances in operation or to consult the HSE Certificate of Exemption No.1 2008, for which further guidance is given in Technical Bulletin 021 [37] (available via the Gas Safe Register website [4]).

In addition to confirming the appliance operating pressure or heat input or, where necessary, both, the combustion performance of the appliance should be checked with a suitable combustion performance analyser and confirmed to be within the tolerances laid down in the appliance manufacturers' instructions (where available) or BS 7967.

[4] www.gassaferegister.co.uk [viewed: 28 October 2015].

11 Maintenance

*COMMENTARY ON CLAUSE **11***

The maintenance of the pipework after commissioning is the duty of the responsible person.

11.1 The maintenance of pipework, including safety devices, shall ensure the continued safety of the installation.

11.2 Any redundant pipework shall be disconnected and, where practicable, removed. Any redundant pipework that has not been removed shall be isolated and sealed at each end with an appropriate fitting.

11.3 Where filters have been installed on the pipework, these shall be periodically checked and cleaned (see also Annex B).

11.4 Where flexible pipework connections have been installed, they shall be periodically checked and replaced as necessary (see **9.1.2**, **9.1.8** and **9.1.9**).

Annex A (informative) Guide to sizing pipework installations

A.1 General

Basic flow analysis problems can be solved readily using a computer program or a hand-held disc calculator.

To assist in providing an example of a method for designing an installation and calculating the required size of a pipework installation, Tables A.1, A.2, A.3, A.4 and A.5 are provided for information only.

Due to the diversity of variables that need to be considered when sizing a pipework installation, such as changes in pipework manufacture standards over the years and the changes to pipework bores, etc., it is impossible to cover every possible scenario. Therefore, a number of reasonable assumptions have been made in these tables, which are also provided for information only.

Operatives should obtain accurate pressure loss data from the pipework manufacturer when undertaking the design process specified by **5.2**.

A.2 Theories and other reasonable assumptions utilized in formulating Tables A.1, A.2, A.3 and A.4

The following formula has been used in calculating the values in Tables A.1, A.2, A.3 and A.4.

$$Q = 57.1\times10^{-5}[pd^5(sLf)^{-1}]^{0.5} \quad \text{(A.1)}$$

where:

Q is the gas flow rate (m^3/h);

p is the pressure loss (mbar);

d is the internal pipe diameter (mm);

s is the density of gas relative to air;

L is the length of pipe (m); and

f is the friction factor.

The density of gas relative to air (s) is taken to be:

- 0.6 for natural gas; and
- 1.5 for LPG.

The friction factor, f, is very difficult to predict with accuracy. It is dependent on a number of variables, including pipe roughness, velocity and Reynolds number. For the smooth pipe law a reliable value can, however, be obtained from:

$$f \approx f_{sp}/e^2 \quad \text{(A.2)}$$

where:

f_{sp} = $(14.7519 + 3.5657X + 0.0362X^2)^{-2}$ and is the smooth pipe friction factor (dimensionless), where:

X = $\log_{10}$ Re – 5, where:

Re is the Reynolds number: and

e is the efficiency factor (assumed as 0.86 for steel tube, 0.95 for copper tube and 0.97 for PE pipe).

In the UK, the Reynolds number is taken to be equivalent to:

- 25 043 × *Q*/*d* for natural gas; and
- 83 955 × *Q*/*d* for LPG.

The preceding formulae are not valid for pliable corrugated (stainless-steel) tubing conforming to BS EN 15266 or BS 7838. Further information should be obtained from the manufacturer.

The calorific value utilized to determine heat inputs (gross) contained in Tables A.1, A.2, A.3 and A.4 is:

- 38.9 MJ/m^3 for natural gas; and
- 93.1 MJ/m^3 for LPG.

The ratio of gross:net heat input is approximately 1.11:1 for natural gas, 1.09:1 for propane and 1.08:1 for butane. Whilst the conversion of rated input between gross and net values strictly depends on the calorific value of gas used, in practical terms a common factor 1.1 has been used.

Table A.1 **Approximate natural gas pressure loss data (mbar/m) – copper tube** *(1 of 4)*

Flow rate (m^3/h)	Heat input		Nominal pipe size (mm/R) [A]						
	Gross (kW)	Net (kW)	8 (6)	10 (8)	12 (10)	15 (13)	22 (19)	28 (25)	35 (32)
0.25	2.70	2.46	0.2675	0.0710	0.0255	0.0077	0.0014	0.0004	0.0001
0.50	5.40	4.91	0.8348	0.2188	0.0777	0.0231	0.0040	0.0011	0.0004
0.75	8.10	7.37	–	0.4285	0.1514	0.0447	0.0077	0.0022	0.0007
1.00	10.81	9.82	–	0.6940	0.2444	0.0719	0.0123	0.0035	0.0011
1.25	13.51	12.28	–	–	0.3553	0.1042	0.0178	0.0050	0.0016
1.50	16.21	14.73	–	–	0.4833	0.1414	0.0240	0.0067	0.0021
1.75	18.91	17.19	–	–	0.6276	0.1832	0.0311	0.0086	0.0027
2.00	21.61	19.65	–	–	0.7877	0.2296	0.0388	0.0108	0.0034
2.25	24.31	22.10	–	–	0.9630	0.2804	0.0473	0.0131	0.0042
2.50	27.01	24.56	–	–	–	0.3353	0.0565	0.0156	0.0049
2.75	29.72	27.01	–	–	–	0.3945	0.0663	0.0183	0.0058
3.00	32.42	29.47	–	–	–	0.4577	0.0769	0.0212	0.0067
3.25	35.12	31.93	–	–	–	0.5249	0.0880	0.0243	0.0077
3.50	37.82	34.38	–	–	–	0.5960	0.0998	0.0275	0.0087
3.75	40.52	36.84	–	–	–	0.6709	0.1123	0.0309	0.0097
4.00	43.22	39.29	–	–	–	0.7496	0.1253	0.0345	0.0108
4.25	45.92	41.75	–	–	–	0.8321	0.1390	0.0382	0.0120
4.50	48.63	44.20	–	–	–	0.9182	0.1533	0.0421	0.0132
4.75	51.33	46.66	–	–	–	–	0.1681	0.0462	0.0145
5.00	54.03	49.12	–	–	–	–	0.1836	0.0504	0.0158
5.25	56.73	51.57	–	–	–	–	0.1996	0.0548	0.0172
5.50	59.43	54.03	–	–	–	–	0.2162	0.0593	0.0186
5.75	62.13	56.48	–	–	–	–	0.2334	0.0640	0.0200
6.00	64.83	58.94	–	–	–	–	0.2511	0.0688	0.0215
6.25	67.53	61.40	–	–	–	–	0.2694	0.0738	0.0231
6.50	70.24	63.85	–	–	–	–	0.2882	0.0789	0.0247
6.75	72.94	66.31	–	–	–	–	0.3076	0.0842	0.0263
7.00	75.64	68.76	–	–	–	–	0.3275	0.0896	0.0280
7.25	78.34	71.22	–	–	–	–	0.3480	0.0952	0.0297
7.50	81.04	73.67	–	–	–	–	0.3690	0.1009	0.0315
7.75	83.74	76.13	–	–	–	–	0.3905	0.1068	0.0333
8.00	86.44	78.59	–	–	–	–	0.4126	0.1128	0.0352
8.25	89.15	81.04	–	–	–	–	0.4352	0.1189	0.0371
8.50	91.85	83.50	–	–	–	–	0.4583	0.1252	0.0390
9.00	97.25	88.41	–	–	–	–	0.5060	0.1381	0.0431
9.50	102.65	93.32	–	–	–	–	0.5559	0.1517	0.0473
10.00	108.06	98.23	–	–	–	–	0.6077	0.1657	0.0516
11.00	118.86	108.06	–	–	–	–	0.7173	0.1955	0.0608
12.00	129.67	117.88	–	–	–	–	0.8348	0.2273	0.0707
13.00	140.47	127.70	–	–	–	–	0.9600	0.2612	0.0812
14.00	151.28	137.53	–	–	–	–	–	0.2972	0.0923
15.00	162.08	147.35	–	–	–	–	–	0.3351	0.1040
16.00	172.89	157.17	–	–	–	–	–	0.3750	0.1164

[A] There are a number of internal bores available for the given nominal pipe sizes. For the purpose of this table the assumed internal bore utilized for calculation of pressure loss values documented is shown in brackets.

Table A.2 **Approximate natural gas pressure loss data (mbar/m) – steel tube** *(2 of 4)*

Flow rate (m^3/h)	Heat input		Nominal pipe size (mm/R) [A]					
	Gross (kW)	Net (kW)	8/R1/4 (8.6)	10/R3/8 (12.1)	15/R1/2 (15.8)	20/R3/4 (21.3)	25/R1 (26.9)	32/R1 1/4 (35.6)
0.25	2.70	2.46	0.0621	0.0130	0.0039	0.0010	0.0004	0.0001
0.50	5.40	4.91	0.1908	0.0393	0.0115	0.0029	0.0010	0.0003
0.75	8.10	7.37	0.3731	0.0761	0.0221	0.0056	0.0019	0.0005
1.00	10.81	9.82	0.6037	0.1225	0.0354	0.0089	0.0030	0.0008
1.25	13.51	12.28	0.8792	0.1777	0.0512	0.0128	0.0043	0.0012
1.50	16.21	14.73	–	0.2414	0.0693	0.0172	0.0058	0.0016
1.75	18.91	17.19	–	0.3130	0.0897	0.0222	0.0075	0.0020
2.00	21.61	19.65	–	0.3924	0.1123	0.0278	0.0094	0.0025
2.25	24.31	22.10	–	0.4793	0.1370	0.0338	0.0114	0.0031
2.50	27.01	24.56	–	0.5735	0.1637	0.0404	0.0136	0.0037
2.75	29.72	27.01	–	0.6748	0.1924	0.0474	0.0159	0.0043
3.00	32.42	29.47	–	0.7831	0.2230	0.0549	0.0184	0.0050
3.25	35.12	31.93	–	0.8982	0.2556	0.0628	0.0210	0.0057
3.50	37.82	34.38	–	–	0.2901	0.0712	0.0238	0.0064
3.75	40.52	36.84	–	–	0.3264	0.0801	0.0268	0.0072
4.00	43.22	39.29	–	–	0.3645	0.0893	0.0299	0.0080
4.25	45.92	41.75	–	–	0.4044	0.0991	0.0331	0.0089
4.50	48.63	44.20	–	–	0.4461	0.1092	0.0364	0.0098
4.75	51.33	46.66	–	–	0.4896	0.1198	0.0400	0.0107
5.00	54.03	49.12	–	–	0.5347	0.1307	0.0436	0.0117
5.25	56.73	51.57	–	–	0.5816	0.1421	0.0474	0.0127
5.50	59.43	54.03	–	–	0.6302	0.1539	0.0513	0.0137
5.75	62.13	56.48	–	–	0.6804	0.1661	0.0553	0.0148
6.00	64.83	58.94	–	–	0.7323	0.1787	0.0595	0.0159
6.25	67.53	61.40	–	–	0.7859	0.1917	0.0638	0.0171
6.50	70.24	63.85	–	–	0.8410	0.2050	0.0682	0.0182
6.75	72.94	66.31	–	–	0.8978	0.2188	0.0727	0.0195
7.00	75.64	68.76	–	–	0.9562	0.2329	0.0774	0.0207
7.25	78.34	71.22	–	–	–	0.2474	0.0822	0.0220
7.50	81.04	73.67	–	–	–	0.2623	0.0872	0.0233
7.75	83.74	76.13	–	–	–	0.2776	0.0922	0.0246
8.00	86.44	78.59	–	–	–	0.2933	0.0974	0.0260
8.25	89.15	81.04	–	–	–	0.3093	0.1027	0.0274
8.50	91.85	83.50	–	–	–	0.3257	0.1081	0.0288
9.00	97.25	88.41	–	–	–	0.3595	0.1193	0.0318
9.50	102.65	93.32	–	–	–	0.3948	0.1309	0.0349
10.00	108.06	98.23	–	–	–	0.4316	0.1430	0.0381
11.00	118.86	108.06	–	–	–	0.5093	0.1687	0.0449
12.00	129.67	117.88	–	–	–	0.5925	0.1961	0.0521
13.00	140.47	127.70	–	–	–	0.6811	0.2253	0.0598
14.00	151.28	137.53	–	–	–	0.7751	0.2562	0.0680
15.00	162.08	147.35	–	–	–	0.8744	0.2889	0.0766
16.00	172.89	157.17	–	–	–	0.9788	0.3233	0.0857

[A] There are a number of internal bores available for the given nominal pipe sizes. For the purpose of this table the assumed internal bore utilized for calculation of pressure loss values documented is shown in brackets.

Table A.3 **Approximate LPG (propane) pressure loss data (mbar/m) – copper tube** *(3 of 4)*

Flow rate (m^3/h)	Heat input		Nominal pipe size (mm/R) [A)]						
	Gross (kW)	Net (kW)	8 (6)	10 (8)	12 (10)	15 (13)	22 (19)	28 (25)	35 (32)
0.25	6.47	5.88	0.4413	0.1148	0.0405	0.0119	0.0021	0.0006	0.0002
0.50	12.93	11.76	1.4367	0.3705	0.1298	0.0379	0.0064	0.0018	0.0006
0.75	19.40	17.63	–	0.7421	0.2590	0.0753	0.0127	0.0035	0.0011
1.00	25.86	23.51	–	1.2194	0.4246	0.1231	0.0206	0.0057	0.0018
1.25	32.33	29.39	–	1.7959	0.6243	0.1807	0.0302	0.0083	0.0026
1.50	38.79	35.27	–	–	0.8565	0.2474	0.0412	0.0113	0.0035
1.75	45.26	41.14	–	–	1.1200	0.3231	0.0537	0.0147	0.0046
2.00	51.72	47.02	–	–	1.4137	0.4074	0.0676	0.0185	0.0058
2.25	58.19	52.90	–	–	1.7369	0.5001	0.0829	0.0227	0.0071
2.50	64.65	58.78	–	–	–	0.6009	0.0995	0.0272	0.0085
2.75	71.12	64.65	–	–	–	0.7097	0.1174	0.0320	0.0100
3.00	77.58	70.53	–	–	–	0.8264	0.1365	0.0372	0.0116
3.25	84.05	76.41	–	–	–	0.9508	0.1569	0.0428	0.0133
3.50	90.51	82.29	–	–	–	1.0827	0.1786	0.0486	0.0151
3.75	96.98	88.16	–	–	–	1.2222	0.2014	0.0548	0.0170
4.00	103.44	94.04	–	–	–	1.3690	0.2254	0.0613	0.0191
4.25	109.91	99.92	–	–	–	1.5230	0.2506	0.0682	0.0212
4.50	116.38	105.80	–	–	–	1.6843	0.2770	0.0753	0.0234
4.75	122.84	111.67	–	–	–	1.8527	0.3045	0.0827	0.0257
5.00	129.31	117.55	–	–	–	–	0.3332	0.0905	0.0281
5.25	135.77	123.43	–	–	–	–	0.3630	0.0985	0.0305
5.50	142.24	129.31	–	–	–	–	0.3939	0.1069	0.0331
5.75	148.70	135.18	–	–	–	–	0.4259	0.1155	0.0358
6.00	155.17	141.06	–	–	–	–	0.4590	0.1245	0.0385
6.25	161.63	146.94	–	–	–	–	0.4932	0.1337	0.0414
6.50	168.10	152.82	–	–	–	–	0.5284	0.1432	0.0443
6.75	174.56	158.69	–	–	–	–	0.5648	0.1530	0.0473
7.00	181.03	164.57	–	–	–	–	0.6022	0.1631	0.0505
7.25	187.49	170.45	–	–	–	–	0.6406	0.1735	0.0537
7.50	193.96	176.33	–	–	–	–	0.6801	0.1841	0.0569
7.75	200.42	182.20	–	–	–	–	0.7206	0.1950	0.0603
8.00	206.89	188.08	–	–	–	–	0.7622	0.2062	0.0637
8.25	213.35	193.96	–	–	–	–	0.8048	0.2177	0.0673
8.50	219.82	199.84	–	–	–	–	0.8484	0.2295	0.0709
9.00	232.75	211.59	–	–	–	–	0.9386	0.2538	0.0784
9.50	245.68	223.35	–	–	–	–	1.0329	0.2792	0.0862
10.00	258.61	235.10	–	–	–	–	1.1312	0.3056	0.0943
11.00	284.47	258.61	–	–	–	–	1.3394	0.3616	0.1115
12.00	310.33	282.12	–	–	–	–	1.5632	0.4218	0.1300
13.00	336.19	305.63	–	–	–	–	1.8022	0.4860	0.1498
14.00	362.06	329.14	–	–	–	–	–	0.5543	0.1707
15.00	387.92	352.65	–	–	–	–	–	0.6265	0.1929
16.00	413.78	376.16	–	–	–	–	–	0.7025	0.2162

[A)] There are a number of internal bores available for the given nominal pipe sizes. For the purpose of this table the assumed internal bore utilized for calculation of pressure loss values documented is shown in brackets.

Table A.4 **Approximate LPG (propane) pressure loss data (mbar/m) – steel tube** *(4 of 4)*

Flow rate (m^3/h)	Heat input		Nominal pipe size (mm/R) [A]					
	Gross (kW)	Net (kW)	8/R1/4 (8.6)	10/R3/8 (12.1)	15/R1/2 (15.8)	20/R3/4 (21.3)	25/R1 (26.9)	32/R1 1/4 (35.6)
0.25	6.47	5.88	0.0999	0.0203	0.0059	0.0015	0.0005	0.0001
0.50	12.93	11.76	0.3217	0.0647	0.0186	0.0046	0.0016	0.0004
0.75	19.40	17.63	0.6437	0.1288	0.0368	0.0091	0.0030	0.0008
1.00	25.86	23.51	1.0569	0.2107	0.0600	0.0147	0.0049	0.0013
1.25	32.33	29.39	1.5558	0.3094	0.0878	0.0215	0.0072	0.0019
1.50	38.79	35.27	–	0.4239	0.1201	0.0294	0.0098	0.0026
1.75	45.26	41.14	–	0.5538	0.1567	0.0382	0.0127	0.0034
2.00	51.72	47.02	–	0.6985	0.1974	0.0481	0.0160	0.0043
2.25	58.19	52.90	–	0.8575	0.2421	0.0589	0.0196	0.0052
2.50	64.65	58.78	–	1.0307	0.2908	0.0707	0.0235	0.0063
2.75	71.12	64.65	–	1.2176	0.3432	0.0834	0.0277	0.0074
3.00	77.58	70.53	–	1.4180	0.3994	0.0970	0.0321	0.0086
3.25	84.05	76.41	–	1.6317	0.4594	0.1114	0.0369	0.0098
3.50	90.51	82.29	–	1.8584	0.5229	0.1267	0.0420	0.0112
3.75	96.98	88.16	–	–	0.5900	0.1429	0.0473	0.0126
4.00	103.44	94.04	–	–	0.6606	0.1599	0.0529	0.0140
4.25	109.91	99.92	–	–	0.7347	0.1778	0.0588	0.0156
4.50	116.38	105.80	–	–	0.8123	0.1965	0.0649	0.0172
4.75	122.84	111.67	–	–	0.8933	0.2159	0.0713	0.0189
5.00	129.31	117.55	–	–	0.9776	0.2362	0.0780	0.0207
5.25	135.77	123.43	–	–	1.0652	0.2573	0.0849	0.0225
5.50	142.24	129.31	–	–	1.1562	0.2791	0.0921	0.0244
5.75	148.70	135.18	–	–	1.2504	0.3018	0.0995	0.0263
6.00	155.17	141.06	–	–	1.3478	0.3252	0.1072	0.0284
6.25	161.63	146.94	–	–	1.4485	0.3494	0.1152	0.0305
6.50	168.10	152.82	–	–	1.5524	0.3743	0.1234	0.0326
6.75	174.56	158.69	–	–	1.6594	0.4000	0.1318	0.0348
7.00	181.03	164.57	–	–	1.7695	0.4264	0.1405	0.0371
7.25	187.49	170.45	–	–	1.8828	0.4536	0.1494	0.0395
7.50	193.96	176.33	–	–	1.9992	0.4815	0.1586	0.0419
7.75	200.42	182.20	–	–	–	0.5102	0.1680	0.0443
8.00	206.89	188.08	–	–	–	0.5395	0.1776	0.0469
8.25	213.35	193.96	–	–	–	0.5696	0.1875	0.0495
8.50	219.82	199.84	–	–	–	0.6005	0.1976	0.0521
9.00	232.75	211.59	–	–	–	0.6642	0.2185	0.0576
9.50	245.68	223.35	–	–	–	0.7308	0.2403	0.0633
10.00	258.61	235.10	–	–	–	0.8002	0.2631	0.0693
11.00	284.47	258.61	–	–	–	0.9474	0.3112	0.0819
12.00	310.33	282.12	–	–	–	1.1053	0.3630	0.0955
13.00	336.19	305.63	–	–	–	1.2741	0.4182	0.1100
14.00	362.06	329.14	–	–	–	1.4533	0.4768	0.1253
15.00	387.92	352.65	–	–	–	1.6430	0.5388	0.1416
16.00	413.78	376.16	–	–	–	1.8430	0.6042	0.1587

[A] There are a number of internal bores available for the given nominal pipe sizes. For the purpose of this table the assumed internal bore utilized for calculation of pressure loss values documented is shown in brackets.

Table A.5 **Typical allowances for pressure loss of fittings**

Nominal pipe size			Equivalent length, m				
			Bends		Fittings		
Steel		Copper	45°	90°	90° elbow	Tee [A] *(flow entering from a branch)*	Tee [A] *(flow exiting into a branch)*
≤15 mm	≤R½	≤15 mm	0.15	0.20	0.40	0.75	1.20
20 mm	R¾	22 mm	0.20	0.30	0.60	1.20	1.80
25 mm	R1	28 mm	0.25	0.40	0.80	1.50	2.30
32 mm	R1¼	35 mm	0.30	0.50	1.00	2.00	3.00

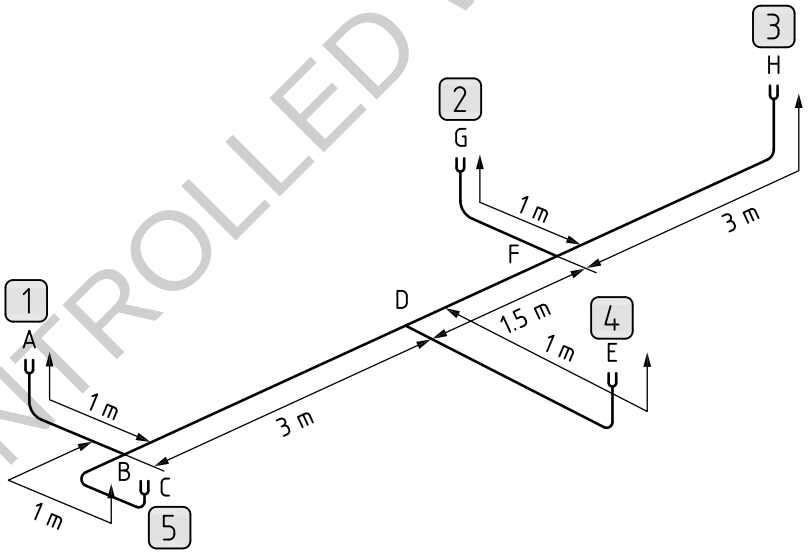
[A] Use the largest connection size on the fitting that is not necessarily the branch size.

NOTE For pressure losses associated with press end fittings, pliable corrugated (stainless-steel) tubing fittings, flexible connections, secondary meters, check valves, regulators, etc., reference needs to be made to the manufacturer's data.

A.3 Example natural gas pipework installation design

Figure A.1 gives an example of a typical natural gas copper tube installation showing the lengths of pipework and the heat input of the appliances. The pipework has been sized using Table A.1 and Table A.5. The results of the design exercise are shown in Table A.6.

Figure A.1 – Example natural gas installation



Key

1 Meter
2 Cooker (11 kW net)
3 Tumble dryer (4 kW net)
4 Combination boiler (30 kW net)
5 Fire (5 kW net)

Table A.6 **Sizing results**

Pipework section	Maximum heat input [A]	Maximum flow rate [A]	Estimated pipe size	Pipe length	Fittings allowance [B]		Adjusted length	Pressure loss/metre	Pressure loss [C]
					Type	Equivalent length			
	kW	m^3/h	mm/DN	m		m	m	mbar/m	mbar
A – B	50 (net)	–	28	1	Elbow × 1 Tee (Enter) × 1	0.80 1.50	3.3	0.0548	0.19
B – C	5 (net)	–	15	1	90° Bend × 2	0.40	1.4	0.0447	0.07
B – D	45 (net)	–	28	3	N/A	0	3.0	0.0462	0.14
D – E	30 (net)	–	22	1	Tee (Exit) × 1 Elbow × 1	2.30 0.60	3.9	0.0880	0.35
D – F	15 (net)	–	22	1.5	N/A	0	1.5	0.0311	0.05
F – G	11 (net)	–	15	1	Tee (Exit) × 1 Elbow × 1	1.80 0.40	3.2	0.1042	0.34
F – H	4 (net)	–	15	3	Elbow × 1	0.40	3.4	0.0231	0.08

Pressure loss to points to be connected on each appliance

Appliance	Maximum heat input	Pipework sections and associated pressure loss				Total pressure loss	Satisfactory?
	kW (net)	mbar				mbar	
Cooker	11	A – B	B – D	D – F	F – G	0.72	Yes
		0.19	0.14	0.05	0.34		
Tumble dryer	4	A – B	B – D	D – F	F – H	0.46	Yes
		0.19	0.14	0.05	0.08		
Combination boiler	30	A – B	B – D	D – E	–	0.68	Yes
		0.19	0.14	0.35	–		
Fire	5	A – B	B – C	–	–	0.26	Yes
		0.19	0.07	–	–		

[A] Either "maximum heat input" or "maximum flow rate" can be specified for the purpose of the design calculations.

[B] Many appliances have horizontal connections, so in practice an additional elbow might be required at each point, and this should be considered in the design process.

[C] All pressures have been rounded up to 2 decimal places.

When designing a pipework installation, it is essential that consideration is given to the permissible pressure loss in each section of the installation.

For example, the pressure loss between A and H in Figure A.1 should not exceed 1 mbar. This section, A to H, is made up of four sections of pipework, A–B, B–D, D–F and F–H. Each section has a different heat input/flow rate requirement and needs to be sized separately.

For this installation, for given heat inputs/flow rates and pipework sizes, the pressure losses per metre length of tube are given in Table A.1. These pressure losses are utilized with the adjusted length [actual length + equivalent length allowance(s) for fittings] to provide a design pressure loss for each given section of the pipework installation. Where the exact heat input/flow rate is not documented, the next heat input/flow rate upwards should be utilized.

When the design pressure loss for each section of this pipework installation has been calculated, the total pressure loss between the meter outlet and the point to be connected on each appliance inlet should be determined. The total pressure loss at each point to be connected on each appliance inlet should not in this example exceed 1 mbar.

If the design pressure loss at any of the appliance inlets exceeds the maximum allowed, in this case 1 mbar, then it is necessary to re-estimate the proposed pipework size(s) for one or more of the sections that supply any affected appliance(s). The design process should then be repeated for all of the sections affected by the revision to the proposed pipework size, and the results re-evaluated. This process should be repeated until the design pressure loss at all of the appliance inlets does not exceed the maximum allowed.

Annex B (informative)

Sulfidation of natural gas installations

Sulfidation ("black dust") is produced by a reaction between trace amounts of hydrogensulfide (H_2S) in gas and domestic copper pipework. The thin, shiny, black flakes of copper sulfide (Cu_2S) break off to be carried along the pipework and into gas appliances, where they accumulate in valves, filters and injectors.

In some gas installations, sulfidation forms a black film on the inner surface of copper gas supply pipework. The thickness of the coating depends on the amount of H_2S in the gas and the thicker the coating, the less stable it becomes, often flaking off and breaking down to form black dust. The maximum amount of H_2S concentration permitted in gas throughout the United Kingdom (UK) is controlled by the Gas Safety (Management) Regulations [8], [9].

Although copper sulfide is described as dust, when first formed it has the appearance of small platelets with a metallic sheen. The platelets are quite brittle and easily break down to become dust, particularly in a fast moving gas stream, where it builds up in and blocks gas valves, filters and injectors. This can result in gas valves failing to operate and reductions in appliance performance. In some extreme cases the build-up can completely block the gas pipework.

The actual rate of production of copper sulfide is dependent upon a number of factors, including:

- size of pipework contributing to high velocity of the gas;
- temperature and configuration of the copper pipework;
- concentration of H_2S in the gas supply;
- oxygen concentration in the gas supply; and
- amount of water vapour in the gas supply.

What remedies are available?

Fit filters to appliances and label to indicate that the appliances have such filters. Change pipework material, e.g. copper to steel or pliable corrugated (stainless-steel) tubing.

Annex C (informative) Summary and principal conclusions of the Advantica Research Project, *Gas in intermediate floors*, Report Number 6699 [28]

NOTE The results and conclusions of this report apply to natural gas installations only and should not, therefore, be applied to installations supplied with LPG or LPG/air gas mixtures.

C.1 Introduction

Regulation 19(6) of the Gas Safety (Installation and Use) Regulations [1] requires adequate ventilation to be present when pipework is located within voids, shafts and ducts.

With the general use of board materials (chipboard, oriented strand board, plywood) as the decking there was concern regarding the level of potential gas build-up within the voids between joists of intermediate floors associated with minor gas leaks.

C.2 Rationale for specification of a minor leak

In developing the specification for this research, it was determined that a minor gas leak is an escape equal to or less than 19 mL/min under the conditions specified in IGEM/UP/1B [38] based upon the following information.

a) Regulation 19(6) of the Gas Safety (Installation and Use) Regulations [1] states, "Where any installation pipework is not itself contained in a ventilated duct, no person shall install any installation pipework in any shaft, duct or void which is not adequately ventilated."

b) BS 6891:1998 (incorporating Amendment Nos. 1 & 2), **8.7.1**, interpreted "adequate ventilation" as "ventilated to ensure that minor gas leakage does not cause the atmosphere to become unsafe."

c) The C&R to BS 6891:1998 (incorporating Amendment Nos. 1 & 2), **8.7.1**, advised that minor gas leakage is "that which would remain undetected by normal soundness testing techniques" and further "the level of ventilation is not intended to clear a major gas escape arising from damage or failure of a gas pipe."

d) IGE/UP/1 [39], IGE/UP/1A [40] and IGEM/UP/1B [38] explained that, "A gas tightness test is a test undertaken to ensure that the leakage rate of an installation is below a level which could be considered to form a hazard assuming adequate ventilation has been provided."

e) IGEM/UP/1B [38] allowed a pressure drop for a domestic gas installation with appliance(s) connected of 4 mbar over a 2 min period. This is based on an average sized installation of 10 L (this includes a U6 meter and pipework). Different volumes (e.g. with different sized meters) allow different pressure drops.

f) The allowable pressure drop equates to an escape rate of 19 mL/min. The smallest leak that can be detected by smell is 1 mL/min; the smallest leak that can be ignited is 14 mL/min.

C.3 Test conditions

Whilst recognizing that there is a wide range of possible test floor layouts and gas leak rates, a project specification was developed to provide data on gas build-up arising from a minor gas leak in a:

a) typical new-build floor;

b) a floor covered to represent a more sealed arrangement; and

c) a floor, including a skirting arrangement and stud walling.

Advantica undertook an experimental study [28], commissioned by the Gas Industry Safety Group (GISG), to make gas concentration measurements within, above and below this representative 3 m^2 floor cassette with typical openings for plumbing and electrical services. The tests were performed using a fixed orifice opening and a range of gas supply pressures to vary the gas leak rate.

C.4 Conclusions

The experimental study reached the following conclusions.

a) In the event of a gas leak from pipework in the floor void, a modern floor construction allows passage of gas across joists and the voids created as a consequence of the installation of electrical and plumbing services.

b) The profiles for gas build-up and decay within the floor compartments and the upper and lower volumes (constructed to represent habitable spaces above and below the floor void) were consistent with theoretical approaches.

c) Adding floor covering above the floor and painting the ceiling under the floor alters the characteristics of the gas concentration build-up within the floor. The more sealed nature of the test results in higher gas concentrations within the floor assembly.

d) The trends in gas concentration across the test floor were always in the order F1 > F2 > F3, F4 and F5. This was expected as the gas leak was in compartment F1 and F2 is the next compartment in the sequence.

NOTE 1 The test floor assembly comprised five compartments 3 m long, 600 mm wide and 241 mm deep with knock outs removed from the I-joists to allow transfer of air and gas from one compartment into adjacent compartments. These compartments were assigned designations F1, F2, F3, F4 and F5, with F1 containing the gas leak.

e) Gas concentrations in compartments F3, F4 and F5 were often similar and reflected the fact that penetrations were added to mimic the effect of plumbing and electrical services penetrating into the floor void. Increased ventilation and leakage were thus possible from these three compartments. However, in the most sealed floor condition F3 was greater that F4 and F5.

f) Measured gas concentrations in the upper (i.e. **above** the test floor) and lower (i.e. **below** the test floor) polythene shrouded volumes were typically lower than those in the floor cassette assembly, reflecting the increased volume of the enclosure and potentially increased ventilation rates through the tape sealed joints. The measured values were often around the threshold levels for odorant detection.

NOTE 2 The polythene shrouded volumes above and below the test floor were to simulate the location of the floor within a home.

g) The measured gas concentration in the lower volume was greater than the upper for all test cases except where the floor had the saw-cut and skirting added.

h) For a gas leak rate of 19mL/min the build-up of gas within the test floor did

not produce a gas concentration greater than 2.5% gas in air, irrespective of floor condition, i.e. the degree of ventilation of the floor void.

i) As anticipated, for gas leakage rates considerably in excess of (e.g. 30 mL/min) a minor gas leak, the build-up of gas within the test floor did produce increased gas in air concentrations within the floor void. These concentrations were also affected by the degree of ventilation of the floor void.

A copy of the full report may be obtained from Advantica, Ashby Road, Loughborough, Leicestershire LE11 3GR; Telephone 01509 282000; Facsimile 01509 283131, quoting Advantica Report Number 6699 "GAS PIPES IN INTERMEDIATE FLOORS". Any questions on the research project and its conclusions should be addressed to Advantica.

Annex D (informative)

Protected area

For the purposes of this standard the term "protected area" is used in relation to fire safety, and is a ventilated space containing gas pipework and isolated from other parts of the building within fire-resisting construction.

NOTE Fire resistance is the ability of a component or construction of a building to satisfy for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476.

The Building Regulations (England and Wales) 2010, as amended [5], the Scottish Building Standards Technical Handbook 2 [41] and Northern Ireland Technical Booklet E [42] provide the following definitions in relation to fire protected areas.

England

a) Protected corridor/lobby. A corridor or lobby which is adequately protected from fire in adjoining accommodation by fire-resisting construction.

b) Protected entrance hall/landing. A circulation area consisting of a hall or space in a flat, enclosed within fire-resisting construction (other than any part which is an external wall of a building).

NOTE For each individual flat, depending on the size of accommodation, its height above ground level, the availability of escape windows and its fire separation from the common stair from which it is accessed, there might be a need under the Building Regulations [5], [6], [7] to provide a protected entrance hall/landing within the flat. In such cases the doors and walls between the entrance hall/landing and the rooms that it serves (normally excluding bathrooms and WCs) would need to be fire resisting. In most circumstances this could be achieved with FD20 fire doors and 30-minute fire-resisting partitions.

In such cases it might be permissible for a pipe/sleeve up to 40 mm internal diameter to pass through the fire-resisting wall/ceiling without further protection, provided it is sealed to the wall/ceiling construction. Any pipe/vented sleeve/vented ducting of larger diameter could require intumescent collars to maintain the required fire protection. The building control body should be consulted for further advice.

c) Protected stairway. A stair discharging through a final exit to a place of safety (including any exit passageway between the foot of the stair and the final exit) that is adequately enclosed within a fire-resisting construction.

d) Compartment floor wall or floor. A fire-resisting wall or floor used in the separation of one fire compartment from another protected shaft.

Scotland

a) Compartment. A part of a building (which might contain one or more rooms, spaces or storeys and includes, where relevant, the space above the top storey of the compartment) constructed so as to prevent the spread of fire to or from another part of the same building, and "compartmented" and "compartmentation" should be construed accordingly.

b) Compartment wall. A wall with the fire resistance required to ensure compartmentation.

c) Compartment floor. A floor with the fire resistance required to ensure compartmentation.

d) Protected enclosure in a dwelling means a circulation area constructed to resist fire in adjoining accommodation. It includes a hall, landing or private stair or ramp but not a room.

e) Protected lobby. A lobby within a protected zone but separated from the remainder of the protected zone so as to resist the movement of smoke from the adjoining accommodation to the remainder of the protected zone.

f) Protected zone. That part of an escape route which is within a building, but not within a room, and to which access is only by way of a protected door and from which there is an exit directly to a place of safety.

Annex E (normative) LPG Final stage regulator and safety devices

E.1 General

E.1.1 The installation shall include a regulator, an over-pressure shut-off (OPSO) device and limited relief valve upstream of the installation pipework. These can be incorporated into a single device. The limited relief valve shall have a maximum capacity not exceeding 5% of the regulator design capacity.

If the installation is supplied from a gas storage vessel (other than a refillable cylinder or a cylinder or cartridge designed to be disposed of when empty), it shall incorporate an under-pressure shut-off (UPSO) device upstream of the installation pipework.

*COMMENTARY ON **E.1.1***

The purpose of the OPSO and limited relief valve is to prevent the installation pipework and gas fittings downstream of the regulator from being subjected to a pressure greater than that for which they were designed, for example if the regulator fails.

The regulator design capacity is the rated capacity of the regulator declared by the manufacturer.

When specifying a regulator it is necessary to confirm that the limited relief valve has a maximum capacity of not greater than 5% of the regulator design capacity.

The purpose of the UPSO is to prevent the installation pipework and gas fittings downstream of the regulator from being subjected to a pressure less than that for which they were designed, protecting the installation if the gas supply pressure falls to a dangerously low level, for example because the LPG storage vessel has become empty.

E.1.2 Pressure regulators shall be installed in accordance with the regulator manufacturer's instructions.

E.1.3 The design of the installation shall ensure a nominal operating pressure at the outlet of the final stage regulator is in accordance with Table E.1.

E.1.4 The regulator and safety devices shall be preset to conform to Table E.1.

Table E.1 **Pressure characteristics of various regulators (LPG)**

Fuel	Nominal outlet pressure mbar	Minimum outlet pressure mbar	Maximum outlet pressure mbar	Maximum lock-up pressure (above set pressure) mbar	Relief valve operating range mbar [A]	UPSO operating range mbar	OPSO operating range mbar [A]
BS 3016 – Cylinder single stage regulator set pressures:							
Butane	28	23	33	+10	–	–	–
Propane	37	32	42	+15	–	–	–
BS 3016 – Final (second) stage regulator set pressures (low pressure):							
Propane	37	32	42	+10	50 – 62 [B]	25 – 32	70 – 80
BS 3016 – Cylinder automatic changeover device set pressures (low pressure):							
Propane	37	32	42	+15	50 – 62 [B]	–	70 – 80
BS EN 12864 or BS EN 16129 – Cylinder single stage regulator set pressures:							
Butane	29	22	35	40	48 – 150	–	48 – 150
Propane	37	27 [C]	45	50	60 – 150	–	60 – 150
BS EN 13785 or BS EN 16129 – Final stage regulator set pressures (low pressure):							
Propane	37	32 [D]	45	50	60 – 150	25 – 32 [E]	60 – 150
BS EN 13786 or BS EN 16129 – Cylinder automatic changeover device set pressures (low pressure):							
Butane	29	22	35	40	48 – 150	–	48 – 150
Propane	37	27 [C]	45	50	60 – 150	–	60 – 150

[A] For BS EN 13785 and BS EN 16129 regulators this operating range is the maximum and minimum values within which the device needs to activate. BS EN 16129 specifies a tolerance on the manufacturer's declared set pressure of ±20% for a relief valve and ±15% for an OPSO.

[B] Normal setting 55 mbar.

[C] Value is the minimum outlet pressure specified in the regulator standard to align with BS EN 437. However, it is recommended that, for the UK market, the minimum operating pressure for propane regulators is 32 mbar.

[D] Due to the UK-agreed UPSO range the minimum outlet pressure for regulators manufactured for the UK market is taken as 32 mbar NOT the 27 mbar declared in BS EN 13785 or BS EN 16129.

[E] Industry-agreed figures for regulators manufactured for the UK market (not formally documented in the standards).

E.2 Location

E.2.1 Regulators and automatic changeover devices shall not be sited:

a) in close proximity to any source of heat or where they might be subjected to extremes of temperature;

b) where they might be exposed to accidental damage;

c) where they might cause an obstruction;

d) where they might be affected by a corrosive atmosphere;

e) where they will constitute a danger to any person;

f) any nearer to electrical wiring, switchgear, etc., than the distances specified in **8.4.2**;

g) in a basement or cellar; or

h) at such a low level that there is a significant risk of them being submerged in the event of flooding.

E.2.2 Regulators incorporating a limited relief valve shall not be sited in a covered passageway or car port except where the passageway or car port has at least two open and unobstructed sides to ensure the area is ventilated.

E.2.3 Regulators and automatic changeover devices connected to cylinders shall be located so that the inlet to the regulator is at or above the level of the cylinder outlet valve connection. They shall not be sited in a covered passageway or car port.

E.2.4 Where there is a regulator downstream of an ECV/AECV, the inlet of the regulator and its safety devices shall be connected as near as practicable to the outlet of that ECV/AECV.

E.2.5 The regulator and limited relief valve vent tip shall be located away from any source of ignition, and in a location and manner not subject to fouling, blockage, water ingress or interference by unauthorized persons.

E.2.6 Diaphragm vent holes and limited relief valves in regulators shall be carefully orientated or otherwise protected against the possible ingress of water or substances which could cause blockage, and also to allow for drainage.

E.2.7 Regulators incorporating a limited relief valve shall not be located within a building.

E.2.8 Regulators incorporating a limited relief valve shall be located so that the limited relief valve vent is terminated in accordance with Table E.2.

E.2.9 Where a regulator incorporating a limited relief valve is located inside an enclosure external to the building, the limited relief valve shall be piped in order to terminate in a safe location in accordance with Table E.2. The tip of any vent pipe shall be securely fixed so it protrudes out of the enclosure by at least 25 mm and points downwards.

NOTE Where the minimum clearances from a limited relief valve tip that is integral to the regulator cannot be achieved, the limited relief can be piped in order to terminate in a safe location in accordance with Table E.2.

Table E.2 **Minimum proximity distances for relief valve vent tips (millimetres)**

Semi-concealed meter box to opening [A)]	Meter housing other than semi-concealed to opening [B)]	Meter housing to electrical equipment [C)]	Vent tip to opening [D)]	Vent tip to electrical equipment [E)]
1 000	180	330	570	850

[A)] This is the distance from the meter box to any un-trapped drain, gully, balanced flue terminal or low-level opening into the building, such as doors or air bricks which are below 250 mm from ground level.

[B)] This is the distance from the meter housing to any opening into the building, such as opening windows, doors, air bricks and balanced flue terminals.

[C)] This is the distance from any meter housing to any electrical equipment.

[D)] This is the distance from any relief valve vent tip to any opening into the property or un-trapped drain or gully.

[E)] This is the distance from the relief valve vent tip to any electrical equipment.

NOTE 1 The limited relief valve has a capacity of not greater than 5% of the regulator design capacity.

NOTE 2 Minimum proximity distances are aligned with those in BS 6400-2 for 2nd family gases and have been confirmed by Calor Gas Limited in accordance with BS EN 60079-10.

E.2.10 The internal diameter of any vent pipe shall not change the performance of the regulator and shall be of sufficient size to vent at the maximum relief valve discharge capacity of the regulator.

NOTE A long vent pipe might require a larger diameter in order to maintain the maximum relief valve discharge capacity and avoid undue back-pressure on the pressure control and protection system.

Annex F (informative)

Dangerous Substances and Explosive Atmospheres Regulations [17], [18]

Gas pipework design and installation for commercial installation undertaken in accordance with this standard has to account for any requirements imposed by DSEAR [17], [18]. However, it is acknowledged that a DSEAR risk assessment might be undertaken by others some time later on the completed installation. Such an assessment could identify issues with the gas installation, which could have arisen as a result of subsequent work undertaken by others on the site after completion of the gas installation or of site-specific risks subsequently identified. It is acknowledged that such issues cannot be assessed at the design or installation stage.

DSEAR principally concerns risks to the safety of workers, rather than risks to property, equipment or business continuation.

DSEAR applies to all businesses where:

a) there is work being carried out by an employer or self-employed person;

b) a dangerous substance is present or is liable to be present at the workplace; and

c) the dangerous substance presents a risk to human safety.

The very wide definition of "workplace" covers any premises or part of premises used for work. "Premises" includes all industrial and commercial premises, land-based and offshore installations, as well as vehicles and vessels. Common parts of shared buildings, private roads and paths on industrial estates, and business parks are also "premises", as are schools, hospitals, restaurants, houses and other domestic dwellings. Basically, if there is a work activity in "premises" as defined then it is a workplace for DSEAR purposes.

The HSE has prepared the following guidance on interpreting DSEAR.

1) L138 *Dangerous Substance and Explosive Atmospheres. Approved Code of Practice and guidance* [43]; and

2) *Fire and Explosion – how safe is your workplace*? INDG 370 [44].

IGEM has prepared the following guidance on interpreting DSEAR:

i) IGEM/UP/2 [12];

ii) IGEM/UP/16 [45]; and

iii) IGEM/SR/25 [46].

The Energy Institute has prepared the following guidance on interpreting DSEAR: EI IP-MCSP-P15 [47].

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